

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 38.

January, 1936.

No. 445.

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD
UNIVERSITY—NO. CX.

THE NORTH AMERICAN REPRESENTATIVES OF RANUNCULUS, § BATRACHIUM

W. B. DREW

(Plate 406)

THE need for a revision of the North American species of the section *Batrachium* of the genus *Ranunculus* was brought to my attention by Professor M. L. Fernald. The North American Batrachian *Ranunculi* have never been intensively studied; but the European representatives of the group have received a great deal of critical attention. It is the purpose of this paper to attempt to make clear the taxonomic and phytogeographic affinities of the North American members of the section.

The first really critical study of the North American representatives of the group was that of Hiern,¹ an English botanist, who, in 1871 treated them in his worldwide survey of the group. Hiern's study is noteworthy because of his conservatism in regarding all the Batrachian *Ranunculi* as forms of a single species, *Ranunculus hydrocharis* Spenn. It is also of interest to note that in this paper Hiern described for the first time the endemic North American *Batrachium*, now known as *Ranunculus Lobbii* (Hiern) Gray. Following Hiern, Lawson,² a Canadian, next treated the North American *Ranunculi* in a study of importance. Lawson, though breaking away from Hiern's inclu-

¹ Hiern, W. P., On the Forms and Distribution over the World of the *Batrachium* Section of *Ranunculus*. Journ. Bot. ix. 43-49; 65-69; 97-107 (1871).

² Lawson, G., Revision of the Canadian *Ranunculaceae*. Trans. Roy. Soc. Canada ii. sect. iv. 44-46 (1884).

sive *Ranunculus hydrocharis*, treated *R. Lobbii* (as had Torrey and Brewer & Watson before him) as a variety of *R. hederaceus* L.; but, these two species are so well marked, as I shall later show in the synoptical section of this paper, that such a course does not now seem justified. Lawson also regarded the strictly American *R. longirostris* Godr., the arctic and subarctic *R. confervoides* Fries, and the Old World *R. Drouetii* F. Schultz as all American and as varieties of *R. aquatilis* L.

In 1886, Gray¹ revised the North American *Ranunculi*; but his study of the section *Batrachium*, though better in respect to the separation of specific entities than Lawson's treatment, reflected the then prevalent opinion that the North American representatives of *Batrachium* were identical, for the most part, with their European relatives. However, as I show in the paragraphs dealing with the geographical distribution in North America of the section *Batrachium*, the majority of our Batrachian *Ranunculi* are endemic to North America. The only other critical treatment of the North American representatives of *Batrachium* is that of Davis,² who made a taxonomical study of the North American *Ranunculaceae* in 1900. In his study, Davis, largely following the earlier (1897) arrangement of Britton and Brown,³ added little to a clearer understanding of *Batrachium* in North America.

DIAGNOSTIC CHARACTERS

GYNOECIUM. In distinguishing between the species of the *Batrachium* section of *Ranunculus*, the mature fruits offer perhaps the most valuable diagnostic characters. The shape of the achenes does not seem to be reliable, except between species which are otherwise not closely related. Length of achenes, providing many measurements of the fruit of a given species are made, is of diagnostic value. Thus, for example, the achenes of *Ranunculus longirostris* range from 1-1.6 mm. in length, whereas those of the closely related *R. subrigidus* are from 1-1.5 mm. long; but the average length of the achene in *R. longirostris* is 1.5 mm., in *R. subrigidus* 1.25 mm. Moreover, *R. Lobbii* may be set off from most of the other Batrachian *Ranunculi* because of its relatively large (2.25 mm. long) achenes. The number

¹ Gray, A., *Revision of the North American Ranunculi*. Proc. Am. Acad. Arts & Sci. xxi. 363-378. (1886).

² Davis, K. C., *Native and Cultivated Ranunculi of North America and Segregated Genera*. Minn. Bot. Studies ii. 460-462. (1900).

³ Ill. Fl. No. U. S. and Can. ii. 83-84. (1897).

of achenes per flower is also significant, although in certain instances, as in *Ranunculus trichophyllus* and its varieties, the value of this character is somewhat lessened by the frequent failure of carpels to reach maturity. In general, however, number of achenes is useful if treated with due regard to the variation in each species. The length and position of the persistent style-base, or beak, are important. The achenes of *Ranunculus longirostris*, for example, may be distinguished from those of all other Batrachian *Ranunculi* by their long beaks (± 1 mm.). The lateral position of the persistent style-base of the achene is significant in *R. Lobbii*, since in the other North American species it is usually subterminal or rarely sublateral.

The pubescence of the fruit, which has been widely employed in distinguishing between species of *Batrachium*, is composed of stout trichomes which are usually localized on the upper or convex side of the achenes. Often, however, the presence of these hairs is affected by the abrading action of running water. Nevertheless, at least one *Batrachium* in North America, *Ranunculus trichophyllus*, var. *calvescens*, appears to have carpels with deciduous trichomes, for the latter, though sparingly present on the immature fruit, are consistently absent at maturity. Among the other Batrachian *Ranunculi*, only *R. hederaceus* and *R. Lobbii* have the achenes glabrous from the first.

The receptacle of the fruit is of some diagnostic value. Thus, in *Ranunculus subrigidus*, the length of the receptacle is usually between 1.75 and 2 mm., whereas in the closely related *R. longirostris*, the receptacle is about 1.25 mm. long. In *R. Lobbii* the receptacle is very short (0.75 mm.) and usually glabrous. The eastern variety of *Ranunculus trichophyllus* (var. *calvescens*) is distinguished from the typical form of the species by its essentially glabrous receptacle. In general, except for *R. Lobbii*, *R. hederaceus* and *R. trichophyllus*, var. *calvescens*, the receptacle of the North American Batrachian *Ranunculi* is pubescent.

ANDROECIUM. Although the shape of the anthers and the relative length of stamens and carpels have often been employed as diagnostic characters, it is probable that the state of maturity of the flower effects such divergences.¹ Thus, these supposed stamineal characters are not of much taxonomic importance. The number of stamens is of some taxonomic significance, though in common with many other characters of the group, it is variable within limits for a given species.

¹ See Freyn, J., *Zur Kenntnis einiger Arten der Gattung Ranunculus* ii., Beil. Bot. Centralbl. vi. nr. 26: 11 (1881).

PERIANTH. The size of the petals of the Batrachian *Ranunculi* is of limited value for classificatory purposes since those of each species, though variable, are of the same general length-range. In two species, *Ranunculus hederaceus* and *R. Lobbii*, the petals are consistently very small (5 mm. in length). In *R. trichophyllus*, however, the size of the petals is much more variable. Finally, in *R. subrigidus*, the veins of the petals are important since they are less forked toward the distal extremity than they are in those of the closely related European *R. circinatus*. The nectarial scales at the base of the petals are, according to Freyn (l. c.), consistently round; but my studies show that the nectaries vary considerably in their development within a given species. Indeed the simple round type is scarcely present in most petals of our North American species. The white color of the petals of the section *Batrachium* is one of the constant characters of the group; but white petals are not confined to the *Batrachium* section, since several species in other sections of the genus also have them. The sepals, while exhibiting several variations in their gross morphology, do not have differences of taxonomic importance.

FOLIAGE. In general the foliage consists of two primary kinds, the dissected, immersed type and the dilated, floating type. In those species which are heterophyllous, all kinds of foliage transitional from one type to the other may be growing even on the same plant. The foliage of the homophyllous species is also very variable. With such foliar variation possible, then, considerable taxonomic discrimination must be exercised in the selection of truly diagnostic foliar characters. The North American plants which are heterophyllous show many variations in their foliage; but, because of the lack of fundamental differences in reproductive structures and since they share a common geographical distribution (western United States and Canada to Alaska), I have concluded that they are better treated as one specific type. Moreover, these heterophyllous North American representatives of *Batrachium* do not offer fundamental distinctions from the more widespread and homophyllous (with dissected, immersed foliage) *R. trichophyllus*. Accordingly, I am treating the American heterophyllous plants as var. *hispidulus* (E. R. Drew) of *R. trichophyllus*. Whether our western plant with heterophyllous foliage is conspecific with the European *R. heterophyllus* Web. is not clear, for the latter appears to be separable in Europe from the types there with dissected immersed leaves.

Among the other dissected-leaved North American species are

Ranunculus longirostris Godr. and my *R. subrigidus*, both of which are characterized by a more or less circinate circumscription of the leaves. In *R. longirostris* the leaves are mostly all sessile at the apex of the stipular sheaths, whereas in *R. subrigidus*, usually the lower and occasionally all the leaves are shortly but definitely petiolate. The leaves of *R. subrigidus*, which has long passed in North America as the European *R. circinatus*, differ from the foliage of the latter in being of a much less rigid texture, and the segments are usually longer.

All the Batrachian *Ranunculi* have stipular sheaths, though variously developed, at the base of the petioles of their leaves. Considerable variation is shown in the morphology of these sheaths, but as specific characters I have not found them of much importance.

MISCELLANEOUS. The presence of adventitious roots, while admittedly a response to severe environmental conditions, appears to characterize the northern plant often passing as *Ranunculus confervoides* Fries. Only rarely do the Batrachia of more temperate regions develop adventitious roots extensively. Similarly, *R. confervoides*, which I am here reducing to a geographic variety, var. *eradicatus* (Laest.), of *R. trichophyllus*, is further characterized by a filiform or very slender stem; but it is doubtful if this character is of much significance.

GEOGRAPHICAL DISTRIBUTION

The section *Batrachium* has a wide geographical distribution. The various species occur chiefly in the temperate regions; *R. trichophyllus*, var. *eradicatus*, however, is found in Greenland as far north as $76^{\circ} 30'$.¹ Another species, *R. pueblensis*, is localized south of the Tropic of Cancer in the highlands of southern Mexico; but, in this case, the altitude (2,000 m.) partially offsets the apparent tropical distribution.

Turning to a consideration of the distribution of the various species in North America, we find significant ranges which, in most cases, can be correlated with those already worked out for many other plants, terrestrial as well as aquatic. One species, *Ranunculus longirostris*, in the East at least, shows a preference for calcareous waters, and it is probable that it and *R. subrigidus* have a similar preference westward. *R. hederaceus* has been reported by Morris² in waters which were probably calcareous. As to the soil preferences of the other

¹ From plants (now in the Gray Herbarium) collected at North Bay, $76^{\circ} 30'$ N. Lat., NW. Greenland, by W. E. Ekblaw of the Crocker Land Expedition.

² According to Morris, E. L., Proc. Biol. Soc. Wash. xiii. 157–158 (1900), *R. hederaceus* was growing in shallow waters over marly soil.

species, however, I have little accurate field data on which to base general conclusions.

Taking up the distribution of each species in North America, it is found that several types of segregation from and identities with Old World floras are manifest. These various types of distribution may be grouped as follows: first, species confined in North America to the East, but growing also in western Europe; second, species confined to western North America, chiefly endemic; third, species of a fairly general range in North America, also endemic; fourth, species of eastern and western North America and western Europe (and probably eastern Asia as well); and, fifth, plants of more general circumpolar distribution in the northern hemisphere.

Ranunculus hederaceus comprises the first group which, in North America, is confined to the East, but which also occurs in western Europe. In North America, *R. hederaceus* occurs at several stations in Newfoundland, in Bucks County, eastern Pennsylvania, and at certain stations around or near the Chesapeake Bay region of Maryland and Virginia. It has also been reported by Elliott¹ from Charleston, South Carolina, where Bosc discovered the plant about 1821. From the fact that Elliott reported the plant as rare or extinct and because more recent studies of the flora of the southeastern United States do not include *R. hederaceus*, there is a question whether it still exists in South Carolina. Evidently Bosc believed the plant to be naturalized from Europe, for Elliott wrote that it was "apparently naturalized." Gray, in 1871, stated that *R. hederaceus* had all the appearance of being indigenous near Norfolk, Virginia. Morris,² however, who discovered a station for *R. hederaceus* at the head of navigation on the Patuxent River, Maryland, presumably regarded the species as introduced from Europe, for he speaks of "The first record by name of station of the introduction of this species from Europe." Thus it may be that *R. hederaceus* is introduced there, but should field studies indicate that the plant is as quiescent or nonaggressive in the Chesapeake Bay region as it is in southeastern Newfoundland, one would have reason to consider it probably indigenous.

From a theoretical standpoint, at least, it is entirely possible that *Ranunculus hederaceus* is indigenous about the Chesapeake Bay region. Its discontinuous distribution in eastern North America, with a gap between eastern Pennsylvania and Newfoundland, is

¹ Sketch Bot. So. Carol. & Ga. ii. 56 (1821).

² Proc. Biol. Soc. Wash. loc. cit.

shared by many other plants, as Fernald¹ has repeatedly pointed out. In his latest study, *Recent Discoveries in the Newfoundland Flora*, Fernald concludes that the plants of austral affinities, such as *Schizaea pusilla* Pursh, the *Xyridaceae* and their associates, which also have a discontinuous range in eastern North America, either lived in Newfoundland throughout the Pleistocene or reached Newfoundland in Pre-Wisconsin time either from the North or the South. It was possible for the plants to migrate to Newfoundland from the North because of the existence of the uplifted floor of the North Atlantic basin which connected North America with Europe. Moreover, it was equally possible for these plants to migrate from the South where, presumably, they had been established long before the Pleistocene, along the now submerged continental shelf which forms the Banks of the present time. This latter idea gains force from the results of the investigations on the New England-Acadian Shoreline by Douglas Johnson² who finds that the continental shelf and banks cuesta were submerged in "at least post-Miocene, and more probably post-Pliocene." Thus the plants already established in the South would have had little difficulty migrating North along the upraised continental shelf; but the point I wish to emphasize is that it was entirely possible for *R. hederaceus* to migrate southward from Newfoundland along the old continental shelf to the Chesapeake Bay region (and probably to South Carolina) where it now persists in scattered favorable localities.

Returning to a consideration of the situation of *Ranunculus hederaceus* in Newfoundland, it seems pretty clear that the plant is indigenous there, since Fernald³ has found it to occur in natural and undisturbed habitats, and to share its Old World affinities with many plants. This group of plants probably made their way across the land which is now the floor of the North Atlantic (or at least were continuously distributed from northern Europe across this land bridge to eastern North America) from northern Europe to eastern North America during the long interglacial epoch prior to the Wisconsin glaciation, and have persisted, especially in southeastern Newfoundland where

¹ A Botanical Exp. to Newfoundland and So. Lab., RHODORA xiii. 135-162 (1911); Some Relationships of the Floras of the No. Hemisph., Proc. Int. Cong. Pl. Sci., Ithaca (1926) ii. 1494-1500 (1929); Specific Segregations and Identities in Some Floras of E. No. Am. and the Old World, RHODORA xxxiii. 25-63 (1931); Recent Discoveries in the Newfoundland Flora, RHODORA xxxv. 97-107 (1933).

² *The New England-Acadian Shoreline*, 301-304 (1925). N. Y., John Wiley & Sons; London, Chapman & Hall.

³ Proc. Int. Cong. Pl. Sci. Ithaca (1926) ii. 1506 (1929).

the Wisconsin ice was very local, as relic species. Thus, *Ranunculus hederaceus*, probably migrating to North America in early or mid-Pleistocene, was widespread on the now submerged continental shelf to Chesapeake Bay, and with its submergence (post-Miocene or post-Pliocene, but pre-Wisconsin) and the ensuing Wisconsin glaciation became isolated in Newfoundland, the Chesapeake Bay region, and South Carolina.

The origin in North America of the second group of species, those endemic to western North America, is not as clearly correlated with geological history as is that of *Ranunculus hederaceus* of the Atlantic coast. *R. Lobbii* of the coast ranges of California, western Oregon, and Vancouver Island, is, however, the most sharply defined species of any North America member of the *Batrachia*, since in its odd, trilobed, dilated leaves, the very small flowers, and the very few (3-6) achenes which are extremely large and possess a lateral mucro, unlike the fruit of any other *Batrachium*, the plant is unique. Its closest relative is the European *R. tripartitus* DC.; but the latter never has the few large achenes with lateral persistent style-bases and the more or less persistent calyces of *R. Lobbii*.

Gray^{1,2} first pointed out the antiquity and relationships of much of the Californian flora, but Jepson³ and Abrams,⁴ with more data at their command, have pointed out the high degree of endemism which characterizes the California plants. Fernald,⁵ again, emphasized that there is a considerable group of plants in the northern hemisphere which occur in Europe and Pacific America, but which are absent from eastern Asia and eastern America. The explanation and origin of this type of distribution is not clear; Fernald points out that, although the climate of Pacific America and Atlantic Eurasia are similar, it is difficult to believe that climate alone could have brought about such a segregation. *Ranunculus Lobbii*, then, is a plant endemic to western North America (chiefly California), and like much of the Californian flora is old. Its origin is not clear, except that it is probable that it and its closest relative, *R. tripartitus*, of Europe have evolved from a common progenitor.

Restricted to the Far West, also, is the heterophyllous and endemic extreme of *Ranunculus trichophyllus* which I am treating as *R. tricho-*

¹ Mem. Am. Acad. Arts & Sci. vi. 377-452 (1859).

² Proc. Am. Ass. Ad. Sci. xxi. 1-31 (1872).

³ Man. Fl. Pl. Calif. 10-14 (1925).

⁴ Proc. Int. Cong. Pl. Sci. Ithaca (1926) ii. 1520-1524 (1929).

⁵ Proc. Int. Cong. Pl. Sci. Ithaca (1926) ii. 1489-1491 (1929).

phyllus, var. *hispidulus*. This plant ranges up the coast to Alaska and occurs as far East as western Montana and Utah. Unlike *R. Lobbii*, whose characters are sharply defined, *R. trichophyllus*, var. *hispidulus* has been a very baffling plant to interpret taxonomically, for certain of its forms appear to be referable to groups which, in Europe, have been treated as distinct species. The American plants seem to be inseparable one from the other, whereas in the Old World species bearing heteromorphic leaves such divergences of several species appear to be distinct. On that account and because I cannot specifically separate our western plant with dilated leaves from *R. trichophyllus*, as the latter occurs in North America, I am treating it as a variety of that species. More extensive studies may show that our western plant with dilated leaves includes one or more Old World types, but, for the present, I believe it is best treated as endemic to our continent. As in the case of *R. Lobbii*, its origin in western North America is not clear. It is probable, however, that *R. trichophyllus*, var. *hispidulus* and its European representatives evolved from a common progenitor, because the plants from both continents are taxonomically closely related.

The third group of species, which are also endemic, are those which are fairly widespread over the chiefly calcareous regions of North America. The most clear-cut of these plants is *Ranunculus longirostris*. This species attains its greatest development in the limy waters of the Great Lakes region, occurring only occasionally in the Southwest. This type of distribution is shown by many plants preferring calcareous soils, as, for example, *Potamogeton strictifolius* Ar. Benn.¹ *Ranunculus subrigidus* also seems to favor waters which are basic; but, curiously enough, it is mostly absent from the calcareous lakes and ponds of the Great Lakes region where *R. longirostris* reaches its greatest development. *R. subrigidus* is more characteristic of the West and Southwest and is much more widely dispersed than *R. longirostris*. Whether *R. subrigidus* is confined to limy waters I am not positive, since my data are incomplete on this subject. At any rate, *R. subrigidus* is very closely related, taxonomically, to the European *R. circinatus*. Presumably, then, *R. subrigidus* and *R. circinatus* had as a common ancestor a plant which was distributed continuously from Europe to North America in Cretaceous or Tertiary time.

The species of the fourth group occur in both eastern and western

¹ *The Linear-Leaved North American Species of Potamogeton*, Mem. Am. Acad. xvii. pt. 1: 55-60 (1932).

North America, as well as in western Europe and probably eastern Asia. *Ranunculus trichophyllus* has a discontinuous range; with rare exceptions, it is absent from most of the Mid-West. In the eastern part of our continent it grows in either basic, neutral or acidic waters, but I have had no personal acquaintance with its habitats in the West. It has a range which, as Fernald¹ has shown, is shared by many other plants, terrestrial as well as aquatic. He has pointed out that such plants as *Potamogeton pusillus*, *P. epihydrus*, *Brasenia Schreberi* and others he cites, are chiefly excluded from the Great Plains by alkalinity of the waters. He presupposes a continuous distribution across the continent in median latitudes during Tertiary time and long after the withdrawal of the Cretaceous seas for these aquatic and the many terrestrial plants which share their ranges. Then, with the advent of the Pliocene uplift of the Cordilleran region, which brought about an increase of aridity east of the Pacific slope, the waters naturally became more alkaline, so that the *Potamogetons* mentioned above, as well as other plants of less alkaline to acid waters, were excluded. With little accurate field data on the soil preferences of *R. trichophyllus*, it is difficult, not to say unwise, to attempt generalizations concerning its distribution; it may be that further studies will indicate that it should be included with those plants just discussed, the distribution of which appears to depend upon proper edaphic conditions.

Finally, another type of distribution is illustrated by the nearly circumpolar *Ranunculus trichophyllus*, var. *eradicatus*. As far as my studies have shown, this arctic and sub-arctic plant is nothing but the extreme northern form of *R. trichophyllus*. Its present distribution in North America is wide, the plant occurring in Labrador, Newfoundland, parts of the Gaspé Peninsula, the James Bay region, northern Wyoming and Alaska. It is fairly common in Greenland, at least on the west coast where it gets as far north as 76° 30'; it is found also in Iceland, northern England, Scandinavia, rarely in the high mountains of France and Italy, and in eastern Eurasia. Such wide arctic and sub-arctic dispersal is characteristic of many plants. It seems to me that *R. trichophyllus*, var. *eradicatus* represents a northern variation of *R. trichophyllus* which gradually evolved from the widespread typical form as the Pleistocene glaciations brought about an increasingly colder climate in the northern areas. This is supported by the fact that it does not differ fundamentally from typi-

¹ *The Linear-Leaved North American Species of Potamogeton*, Mem. Am. Acad. xvii. pt. 1: 27-28 (1932).

cal *R. trichophyllus*, and also because it appears to occur further south in Europe, at least, in alpine regions where the climatic conditions are of near-arctic severity.

SYNOPTIC TREATMENT OF THE NORTH AMERICAN SPECIES

My thanks are especially due to the United States National Museum and the University of California for loan of their collections. I also wish to extend my thanks to Dr. Cotton of the Royal Botanical Gardens at Kew, England, for placing their collection at my disposal. Dr. Pennell of the Academy of Natural Sciences at Philadelphia and Dr. Merrill of the New York Botanical Garden have most kindly lent me the plants which comprise the original collection of *Ranunculus Porteri* Britton. In this paper, the material from the Gray Herbarium and from the Herbarium of the New England Botanical Club has not been specially indicated. Other collections are indicated as follows: Boston University (B. U.), United States National Herbarium (U. S.) and University of California (Cal.).

In this paper I am regarding *Batrachium* as a section of *Ranunculus* and not as a separate genus, because the definitive characters of *Batrachium*, in the final analysis, are not restricted to it. Whether *Batrachium* should be considered a section or a sub-section under *Ranunculus* is a question I am in no position to answer, because I am not familiar enough with the other plants of the genus. Prantl¹ has arranged the species of *Ranunculus* according to a system which is based on a wide knowledge of the group, and upon evidence derived from morphological as well as taxonomical investigations. According to this well-established system, *Batrachium* is a sub-section under the section *Marsypadenium*.

KEY TO THE INDIGENOUS NORTH AMERICAN SPECIES AND VARIETIES OF *RANUNCULUS* § *BATRACHIUM*

- a. Plants with dilated floating leaves only, shallowly 3-5-lobed, subtruncate at the base with wide sinuses: achenes glabrous: receptacle glabrous 1. *R. hederaceus*.
- a. Plants with dilated floating leaves and dissected immersed leaves, or only the latter; dilated leaves variously, but not shallowly 3-7-lobed: achenes hairy or glabrous: receptacle hairy (except in *R. Lobbi* and *R. trichophyllus*, var. *calvescens*) b.
- b. Blades of dissected immersed leaves all usually petioled above the stipular sheaths, collapsing when withdrawn from water; stipular sheaths narrow except on the immature leaves, mostly adnate to the petioles c.

¹ Prantl, K., Beit. Morph. Syst. Ranunc., Bot. Jahrb. ix. 263-268 (1888).

- c. Dissected immersed leaves rudimentary and few, usually near the base of the plant: carpels usually 2-6 (av. 3); persistent style-base chiefly lateral to sublateral, inconspicuous. 2. *R. Lobbii*.
- c. Dissected immersed leaves various, usually well developed: carpels 8-40; persistent style-base terminal to sublateral, never lateral, mostly conspicuous. . . . d.
- d. Dilated floating leaves developed; plants of western North America. 3. *R. trichophyllus*, var. *hispidulus*.
- d. Dilated floating leaves undeveloped. . . . e.
- e. Stems rarely filiform, not usually rooting at many of the nodes; segments of dissected leaves rarely filiform: stamens mostly 10-15: achenes usually very rugose. . . . f.
- f. Receptacle mostly long-hairy: achenes 1.25-1.5 mm. long, frequently hairy at maturity. 4. *R. trichophyllus*, var. *typicus*.
- f. Receptacle essentially glabrous: achenes 1.5-1.75 mm. long, glabrous at maturity: plants of eastern North America. 5. *R. trichophyllus*, var. *calvescens*.
- e. Stems filiform, rooting extensively at the nodes: segments of the dissected leaves filiform: stamens usually 5-10: achenes often smooth: plants arctic, subarctic and arctic-alpine. . . . 6. *R. trichophyllus*, var. *eradicatus*.
- b. Blades of dissected leaves sessile above the stipular sheath to rarely petiolate, often remaining firm on withdrawal from water; stipular sheaths mostly broad and well developed on the majority of the leaves, rarely completely adnate to the petioles. . . . g.
- g. Achenes not over 1.6 mm. long, exclusive of the persistent style-base, rather finely rugose; beak not stout and recurved: first divisions of the leaves not long-stalked. . . . h.
- h. Persistent style-base forming a short beak (0.2-0.5 mm.) at maturity; achenes very many (30-80), but usually about 40, averaging 1.25 mm. in length: stipular sheaths pubescent or not, usually $\frac{3}{4}$ to completely adnate to the petioles. 7. *R. subrigidus*.
- h. Persistent style-base forming a long beak (± 1 mm.); achenes several to many (8-30), but usually about 16, averaging 1.5 mm. in length: stipular sheaths very hairy, usually $\frac{1}{4}$ - $\frac{3}{4}$ adnate to the petioles. 8. *R. longirostris*.
- g. Achenes 2-2.75 mm. long, exclusive of the persistent style-base, rather coarsely rugose; beak rather stout and more or less recurved: first divisions of the leaves very long (0.6-1 cm.)-stalked. 9. *R. pueblensis*.

1. *RANUNCULUS HEDERACEUS* L. Stems creeping, with adventitious roots at many of the nodes: dilated leaves only present; blades more or less reniform, shallowly lobed into 3-5 segments; petioles with rather membranaceous, $\frac{1}{2}$ - $\frac{2}{3}$ adnate stipular sheaths: flowers 4-7 (usually 5-6) mm. in diameter: petals 3-5-veined: stamens 6-10: carpels 10-16 (av. 12), mostly glabrous; mature achenes 1-1.5 (av. 1.25) mm. long, sharply keeled all around, absolutely glabrous and prominently rugose; persistent style-base small, subterminal to sublateral: receptacle 1-1.5 (av. 1.25) mm. long, entirely glabrous.—Sp. Pl. 556 (1753); Oeder, Fl. Dan. ii. fasc. vi. 3, t. 321 (1766); Biria,

Hist. Renonc. 33 (1811); Reichenb. Ic. Fl. Germ. iii. t. 2 (1838-39); Gren. & Godr. Fl. Fr. i. 19 (1847); Bab. Man. Brit. Bot. ed. 4: 8 (1856); Gray, Syn. Fl. No. Am. i. 22 (1895); Rob. & Fern. in Gray, Man. ed. 7: 394 (1908); Hegi, Ill. Fl. Mitt.-Eur. iii. 577, t. 118, f. 7 (1912); Pearsall, Bot. Soc. & Exch. Club Brit. Isl. Rep. viii. 837 (1928). *R. Hederæfolius* Salisb. Prod. Stirp. 373 (1796). *Batrachium hederaceum* (L.) S. F. Gray, Nat. Arr. Brit. Pl. ii. 721 (1821). *R. hydrocharis*, β . *Homoiophyllus*, α . *Hederaceus* Spenn. Fl. Frib. iii. 1008 (1829). *B. omoiophyllus* Tenore, Fl. Neapol. iv. 338 (1830).¹ *R. hydrocharis*, forma *hederæfolius* (Salisb.) Hiern, Journ. Bot. ix. 67 (1871). *R. hederaceus* L., var. *hederæfolius* (Salisb.) Lawson, Trans. Roy. Soc. Canada, ii. sect. iv: 44-45 (1884), excluding synonym *R. aquatilis*, var. *arcticus* Durand.—In shallow water and wet shores, Newfoundland; Chester Co., Pennsylvania; Maryland; southeastern Virginia; South Carolina; western Europe. The following are typical: NEWFOUNDLAND: Open Hall Cove, Bonavista Bay, Aug. 16, 1879, *H. L. Osborn* (U. S.), distributed as *R. hyperboreus* Rottb.; shores of Quiddy Viddy Lake, *Robinson & Schrenk*, no. 31; between Quiddy Viddy and Middle Cove, *Fernald & Wiegand*, no. 5423; Murray's Pond, July, 1931, *Agnes M. Ayre*; Bishop Field Grounds, St. John's, July, 1931, *Agnes M. Ayre*; New Harbour, 1890, *Waghorne*; by spring in gravel beach, Carbonear, *Fernald & Wiegand*, no. 5424. PENNSYLVANIA: growing in shallow water along road near Lee's Bridge, Chester Co., *Hans Wilkens*, no. 161. MARYLAND: Mt. Calvert, Prince George Co., *Shreve*, no. 1556 (U.S.); swamp south of the confluence of its western branch with the Patuxent River, Prince George Co., *E. L. Morris*, no. 919 (U.S.); along the Patuxent River for four miles below its western branch, Prince George Co., *E. L. Morris* no. 1407 (U.S.). VIRGINIA: shaded spring bog, Hampton, May 18, 1903, *G. S. Miller, Jr.* (U.S.); south of Virginia Beach, Princess Anne Co., May 26, 1893, *Britton & Small* (U.S.); Hampton, 1878, *Vasey* (U.S.); Norfolk, *L. F. Ward*, no. 826 (U.S.); Dismal Swamp, 1877, *Chickering* (U.S.); Chesapeake City, May 12, 1877, *L. F. Ward* (U.S.); Hampton, May 14, 1877, *Morong* (U.S.); wet sand bordering swampy woods and thickets back of the dunes, along Back Bay, south of False Cape, Princess Anne Co., *Fernald & Long*, no. 3937.

This species is worth more than passing mention in this study because of the interest attached to its various discoveries in North America, and for its significant geographical distribution which I have discussed in the preceding pages. The first collection of the species in North America was made about 1821 at Charleston, South Carolina, where Bosc discovered the plant, according to Elliott.² His note seems to have escaped the attention of later botanists and, apparently, the plant has not subsequently been reported in South Carolina.

¹ According to Pearsall, l. c.

² Sketch Bot. So. Carol. & Ga. ii. 56 (1821).

Thus, Gray¹ wrote, erroneously, as it now appears, that *R. hederaceus* was first collected on this continent near Norfolk, Virginia, where J. M. M. Muir found it in 1870. In the next few years following 1870, *R. hederaceus* was discovered at "Chesapeake City," near Hampton, Virginia, by Dr. L. F. Ward in 1877 and, during the same year, in Dismal Swamp, Virginia, where it was found by Chickering. The next new locality in Virginia was at Virginia Beach, Princess Anne Co., where Britton and Small collected it in 1893. Meanwhile, however, a significant range-extension was made by Dr. H. L. Osborn in 1879, when he collected the plant in Open Hall Cove, Bonavista Bay, Newfoundland. Through the kindness of the United States National Herbarium, I have been able to examine Osborn's plant which is unquestionably *R. hederaceus*. Presumably Gray, at the time (1886) of his Revision of the North American Ranunculi (l. c.) was unfamiliar with Osborn's plant, for he wrote under the discussion of *R. hederaceus*, that although it was said to be apparently indigenous at many stations near Norfolk, Virginia,² the fact that it occurred nowhere else indicated that it was an introduction from Europe. However, in the treatment in the Synoptical Flora of North America i. 22 (1895), Gray's earlier opinion (1886), that *R. hederaceus* was a European introduction, was maintained by the editor even though, at that time, it had been collected by Waghorne in 1889 and 1890 near New Harbour, Bonavista Bay, Newfoundland;³ by Miss Southcott at St. John's, Newfoundland, in 1893;⁴ and by Robinson & Schrenk on the shores of Quiddy Viddy Lake, Newfoundland, in 1894.⁵

Since the publication of the Synoptical Flora, many new stations for the plant have been discovered. Morris, in 1900,⁶ found the species in a swamp near the head of navigation on the Patuxent River, Prince George Co., Maryland. Numerous other collections

¹ Gray wrote, in the note describing the discovery for the "first time" in North America of *Ranunculus hederaceus*, that it was collected by the late Dr. Munn (Am. Journ. Sci. & Arts ser. 3, ii. 476 (1871)). Subsequently, in his *Revision of the North American Ranunculi* (Proc. Am. Ac. Arts & Sci. xxi. 364 (1886)), Gray stated that it was first collected by Muir in 1870. The original collection, now in the Gray Herbarium, bears the name of J. M. M. Muir as collector. Probably, then, Muir was actually the collector, and not Munn.

² As a matter of fact, Gray wrote earlier (1871, l. c.) that *R. hederaceus*, when "first" discovered in North America near Norfolk, Virginia, had all the appearance of being indigenous.

³ Bot. Gaz. xvi. 285 (1891).

⁴ Trans. Nov. Scot. Inst. Sci. ser. 2: i. 363 (1893).

⁵ Notes on Fl. Newf'd., Can. Rec. Sci. vii. 7 (1896).

⁶ Proc. Biol. Soc. Wash. xiii. 157 (1901).

from Carbonear on the shores of Conception Bay and the general vicinity of St. John's, Newfoundland, have added to the known stations for this plant in Newfoundland. More recently (1929), Wilkens discovered a station much further inland at Lee's Bridge, Chester Co., Pennsylvania,¹ and in 1934 Fernald & Long found it with strictly indigenous species on wet sands of Back Bay, near the North Carolina border, south of False Cape, Virginia.

It is evident, then, that *R. hederaceus* was much more widespread than Gray knew when he first revised the North American *Ranunculaceae* (l. c.). Robinson & Schrenk, in "Notes on the Flora of Newfoundland," (l. c.) came to the conclusion that the evidence at that time (1896) was not clear as to whether *R. hederaceus* was indigenous, especially since their stations were near a prominent port. Later and more thorough botanical explorations in Newfoundland, however, indicate that *R. hederaceus* occurs at many stations on the Avalon Peninsula. Thus, Fernald² has pointed out in "Some Relationships of the Floras of the Northern Hemisphere" that *R. hederaceus* is apparently indigenous in Newfoundland, especially since it shares natural and undisturbed habitats with or near many other European types, such as *Potamogeton polygonifolius* Pourret, *Glyceria fluitans* R. Br., *Sieglingia decumbens* Bernh., *Nardus stricta* L., *Calluna vulgaris* (L.) Hull, and *Pedicularis sylvatica* L.

Although Hiern (l. c.) stated that *Ranunculus hederaceus* reaches the Rocky Mountains, where it has "larger flowers and more numerous stamens than in the type," neither extant specimens nor records of the plant in recent floristic studies of the region are known. Indeed the material in the Gray Herbarium, the United States National Herbarium, the Herbarium of the University of California, and the Kew Herbarium includes no authentic specimens of *R. hederaceus* from the Rocky Mountain region or, for that matter, the West as a whole. It seems probable, then, that Hiern was dealing with some other species.

Lawson (l. c.) interpreted Durand's³ *Ranunculus aquatilis*, var. *arcticus*, from "Disco and adjacent coast, 70°," as *R. hederaceus*; but

¹ *Pennsylvania*: growing in shallow water, along road near Lee's Bridge, Chester Co., *Hans Wilkens*, no. 161. (Distributed by the Philadelphia Academy of Sciences).

² *Proc. Int. Cong. Pl. Sci. Ithaca* (1926) ii. 1506 (1929).

³ Durand, in the *Plantae Kaneanae* Groenl., *Journ. Acad. Nat. Sci. Philadel.* iii. 185 (1856), published a new *Ranunculus*, *R. aquatilis* L., var. *arcticus* from "Disco and adjacent coast, 70°." Durand stated that his plant has a great affinity with DeCandolle's "*R. aquatilis*, var. *hederaceus*, *R. hederaceus*, Lam., not of Linn." No plate accompanies the description, and I have seen no specimen, so that I must rely on Porsild's statement as to the nature of Durand's plant.

Porsild¹ has not found *R. hederaceus* either on Disko Island or the adjacent coast, although it is certain that he would have done so if it actually grew there. He has no doubt whatever that the plant which Durand collected was *R. hyperboreus* Rottb., in which the "flowers often become white during drying, especially when the specimens are laid in the press in wet condition." Thus it seems very probable that *R. hederaceus* L. is confined in North America to Newfoundland and to scattered stations from Pennsylvania to southeastern Virginia.

2. *R. LOBBII* (Hiern) Gray. Plants with heteromorphic leaves, both dilated and dissected; leaves all petioled with well developed stipular bases one-half to completely adnate; dilated leaves deeply tripartite, with the lobes at nearly right angles to each other, and secondarily, shallowly, though sharply notched; dissected leaves few, usually rudimentary and confined to the lower nodes: flowers 0.6–1.5 cm. in diameter: veins of the petal 4–6 (av. 5): stamens 12–16 (av. 12) in number: carpels 2–5 (av. 3) per fruiting head, absolutely glabrous; mature achenes 2–2.6 (av. 2.25) mm. long, glabrous, more or less inflated, oblong-ovate, with rugosities more or less continuous and sharply delineated from the surface; persistent style-base short and definitely lateral: receptacle 0.5–1 (av. 0.75) mm. long, conical, thick, not at all narrowed at the base and entirely glabrous.—Proc. Am. Acad. xxi. 364 (1886) and Synop. Fl. i. pt. 1: 22 (1895); Jepson, Man. Fl. Pl. Calif. 391 (1925). *R. hederaceus* L., var., Torrey, Rep. Whipple Exp. 102 (1857); *R. hydrocharis* Spenn., forma *Lobbii* Hiern, Journ. Bot. ix. 66, t. 114 (1871). *R. aquatilis* L., var. *Lobbii* (Hiern) Watson, Bibl. Ind. 17 (1878). *R. hederaceus* L., var. *Lobbii* (Hiern) Brewer & Wats. Bot. Cal. i. 5 (1876); Lawson, Trans. Roy. Soc. Can. ii. sect. iv: 44 (1884). *Batrachium Lobbii* (Hiern) Howell, Fl. Nw. Am. i. 13 (1897).—Vancouver Island, western Oregon, and western California, where it grows chiefly in pools and quiet waters. The following are representative: CALIFORNIA: Mt. Tamalpais, Marin Co., Eastwood, no. 3163 (U.S.); St. Helena, Napa Co., C. F. Baker, no. 1997 (U.S.); Black Mountain, Santa Clara, Elmer, no. 4734 (U.S.); Sonoma Valley, Jepson, no. 5083 (U.S.); Windsor, Sonoma Co., Sidney S. Holman, 1884 (U.S.); near Windsor, Sonoma Co., Heller & Brown, no. 5060 (U.S.); 35th parallel of Latitude, 1853–4, J. M. Bigelow (U.S.); pond on hill, 2 miles south of San Pablo, Apr. 17, 1888, Greene (U.S.); Vacaville, 1892, Jepson (U.S.); Byron Springs, March 25, 1888, Greene (U.S.); in shallow stagnant water, on Tomalis Bay, Apr. 1886, Greene; Mt. Tamalpais, Marin Co., April, 1899, Eastwood; North Berkeley Hills, San Francisco Bay Region, Chandler, no. 787; Fairfax, Marin Co., Apr. 14, 1895, Eastwood; pond in Bolinas, Marin Co., Apr. 15, 1891, Chestnut & Drew (Cal.); Valley Ford, Sonoma Co., 1906, Emma Sobenstein (Cal.); Glen Ellen, Sonoma Co., M. S. Baker, no. 603 (Cal.); pool near Olema, Marin Co., Apr. 27, 1931, L. S. Rose

¹ Meddel. om Grönl. lviii. 79 (1926).

(Cal.); Alfine School House, San Mateo Co., *Elmer*, no. 4734 (Cal.); ponds in Upper Napa Valley, near Calistoga, May 1, 1893, *Jepson* (Cal.); Glenwood, Santa Cruz Co., May 1893, *Michener & Bioletti* (Cal.); Healdsburg, Apr. 1897, *Alice King* (Cal.); Cajadero, Sonoma Co., *J. Burt Davy*, no. 1659 (Cal.); Sebastopol, Apr. 26, 1893, *Eastwood* (Cal.); OREGON: shallow pool in pasture at end of Brook Lane, Corvallis, April 23, 1934, *Gilkey*. VANCOUVER ISLAND: vicinity of Victoria, *John Macoun*, no. 77,391; Colwood, May 21, 1919, *C. F. Newcombe*; Oak Bay, May 9, 1901, *N. S. Gardner* (Cal.).

Ranunculus Lobbii is one of the most sharply defined of any of the North American *Batrachia*. In the paucity of carpels (3–6), the large glabrous achenes with lateral beaks, and the distinctly tripartite dilated leaves, it stands apart from all the North American members of the group. Gray,¹ who had seen very few specimens of this *Ranunculus*, noted that it had sharply defined style-characters, but that, contrary to what Torrey had earlier (1857) reported, the style was never lateral, either in flower or at a later period. My observations indicate that, at least in fruit, the style-base is usually definitely lateral (FIG. 12) unlike that of the achenes of any other *Batrachium*. In the large size (2.25 mm. \pm), the very few achenes, and the distinctly lateral beak in fruit, *R. Lobbii* is clearly separated from the European *R. tripartitus*, considered by many students to be its closest relative. Some of the earlier authors regarded *R. hederaceus* as the nearest relative of *R. Lobbii*, even going so far as to include them under one species; but, again, the fruit characters of *R. Lobbii* and the fact that it usually bears dissected, immersed foliage, though often rudimentary, clearly distinguish it from *R. hederaceus*. *R. Lobbii*, then, is a species endemic to western North America.

It is of interest to note that Hiern² originally described this plant as a form under his inclusive *Ranunculus hydrocharis* Spenn. Hiern's plant, which was collected by W. Lobb in Oregon (no. 249), is now in the Kew Herbarium where I have examined it. Apparently *R. Lobbii* centers chiefly upon the coast ranges of Mid-California, although it is also in western Oregon and on Vancouver Island.

3. *R. TRICHOPHYLLUS* Chaix. Leaves dilated and floating or dissected and immersed, with transitional forms common; dilated leaves variously lobed, chiefly confined to the upper nodes, subtended by broader, less completely adnate and more pubescent stipular sheaths than the dissected leaves; dissected leaves of varying length, shape, and disposition about the stem, usually collapsing out of water; stipular sheaths generally narrow, one-half to completely adnate, except

¹ Proc. Am. Acad. xvi. 1. c.

² Journ. Bot. ix. loc. cit.

when quite young; upper internodes, petioles and lower leaf-segments often hairy: flowers varying from 0.7 to 1.7 (usually 1.2–1.5) cm. in diameter; petals not usually contiguous, exceeding the calyx by about 2–2.5 times; veins of the petal variable, ranging from 3 to 9 (usually 5–6 for eastern forms and 3–4 for the western ones): stamens 5 to 16 (usually 10–12): carpels 8 to 35 (usually 16–24), with often several abortive at maturity; achenes 1 to 2 (usually 1.25–1.5) mm. long, hairy or not; summit of style mostly deciduous, leaving a short persistent beak subterminal to sublateral in position: receptacle 0.5 to 2.6 (usually 1.–1.5) mm. long, pubescent or not.—A very variable plant found in temperate and cold regions. Its many forms have often been described as distinct species, especially in Europe. In North America at least three varieties and several forms can be distinguished.

R. TRICHOPHYLLUS Chaix, var. **typicus** (FIGS. 6, 13). *R. trichophyllum* Chaix in Villars, Hist. Pl. Dauph. i. 335 (1786); Grenier & Godron, Fl. France i. 23–24 (1847); Bab. Man. Eng. Bot. ed. 5: 5–6 (1862); Sm. & Sowerby, Engl. Bot. Suppl. v. no. lxxvii, t. 2968 (1863); Coste, Fl. Fr. i. 22 (1901); Pearsall, Bot. Soc. & Exch. Club Brit. Is. Rep. viii. 818–819 (1928). *R. aquatilis* L., var. γ L. Sp. Pl. i. 556 (1753), in part. *R. foeniculaceus* Gilib. Fl. Lithuan. iv. 261, n. 177 (1782), in part, according to F. N. Williams. *R. divaricatus* Schrank, Baierische Fl. ii. 104, n. 859 (1789), in part, not as interpreted by early European authors. *R. flaccidus* Pers. in Usteri, Ann. d. Bot. xiv. 39 (1795), in part. *R. capillaceus* Thuill. Fl. Env. Paris, ed. 2: 278 (1799), in part. *R. pantothrix* Brotero, Fl. Lusit. ii. 375 (1804), in part, excluding synonyms *R. aquatilis* L., var. β & δ . *R. paucistamineus* Tausch, in Flora xvii. 525 (1834), in part, of English authors. *R. aquatilis* L., var. *brachypus* Hook. & Arn. Bot. Beech. Voy. pt. 7: Calif-Suppl. 316 (1840). *Batrachium trichophyllum* (Chaix) Van d. Bosch, Prod. Fl. Bat. i. 5 (1850). *R. hydrocharis* Spenn., forma *trichophyllum* (Chaix) Hiern, Journ. Bot. ix. 101 (1871). *R. aquatilis* L., var. *Drouetii sensu* Lawson, Trans. Roy. Soc. Can. ii. 45–46 (1884). *R. Porteri* Britton, Bull. Torr. Bot. Club xvii. 310 (1890). *B. pedunculare* Greene ex C. F. Baker, West Am. Pl. ii. 8 (1903), name only; Leaflets Bot. Obs. & Crit. i. 95 (1904). *B. Bakeri* Greene ex C. F. Baker, West Am. Plants i. 7 (1902), name only; Leaflets Bot. Obs. & Crit. i. 95 (1904). *R. aquatilis* L., var. *Bakeri* (Greene) Jepson, Man. Flr. Pl. Calif. 391 (1925). *R. aquatilis* L., var. *pedunculare* (Greene) Jepson, loc. cit. (1925).—A common plant in streams and ponds, from Labrador, Newfoundland, Quebec, and Nova Scotia, occasionally in New England, south to northern New Jersey; Minnesota, Alberta, west to the coast from Lower California to Alaska, south to New Mexico and Arizona; Eurasia; Cape of Good Hope; temperate South America. The following are representative: LABRADOR: Rama, A. Stecker, no. 331; Anatolak, Sewall, no. 510. NEWFOUNDLAND: in a cold brook four miles northeast of Port à Port, Mackenzie & Griscom, no. 10284; Otter Pond Brook, Brig Bay, Fernald, Wiegand, Long, Gilbert & Hotchkiss, no. 28248; in dead water near tide-limit,

East Brook, St. Barbe Bay, *Wiegand & Hotchkiss*, no. 28249; limestone barrens, Sandy (or Poverty) Cove, Straits of Belle Isle, *Pease & Griscom*, no. 28243; gravelly margin of brook, flowing through clay, slates, sandstones, and quartzites, Upper Gully, Killigrew's, *Fernald & Wiegand*, no. 5420. QUEBEC: Rivière aux Becscies, Anticosti, *Victorin & Rolland*, no. 25631; La Madeleine, Gaspé Co., *Rousseau*, no. 31089; in a deep quiet brook, Bradore, Saguenay Co., *Fernald & Wiegand*, no. 3407; Five Mile Rapids, Roberval, Saguenay Co., July 16, 1892, *Geo. G. Kennedy*; fresh pools near mouth of Dartmouth River, Gaspé Co., *Collins, Fernald, & Pease*, n. 5229; Rivière Petite Cascapedia, Bonaventure Co., *Victorin, Rolland & Jacques*, no. 33,822; estuaire de la Rivière York, Gaspé Co., *Victorin, Rolland, Brunel & Rousseau*, no. 17352; Sargents Bay, Lake Memphramagog, Aug. 1, 1903, *Churchill*; fresh-water pond near beach at Point Comfort, South Coast, James Bay, *David Potter*, no. 357; environs d'Ottawa, *Victorin*, no. 10084 (U.S.); Lac à la Truite, *Victorin*, no. 11279 (U.S.). PRINCE EDWARD ISLAND: brook near Village Green, Queens Co., *Fernald, Long & St. John*, no. 7478, a form with unusual long-segmented, dissected leaves. NEW BRUNSWICK: Nashwaak Bridge, July 20, 1932, *Pease & Goodale*; near St. John River above Connors, St. Francis Parish, Madawaska Co., *A. H. Moore*, no. 1302. NOVA SCOTIA: lowlands near Dingwall, Cape Breton Isl., *Nichols*, No. 941; Cape Breton Isl., *Macoun*, no. 19016; muddy lagoon, Charcoal, Pictou Co., *St. John*, no. 1421; pond, North Mountain, Aspy Bay, Cape Breton, July 23, 1909, *Churchill*. MAINE: St. Francis, Aug. 26, 1893, *Fernald*; Fort Kent, 1881, *Kate Furbish*, approaching var. *calvescens*. NEW HAMPSHIRE: Mud Pond, Connecticut Lakes, *Kendall, Goldsborough & Doolittle*, no. 1 (U.S.). CONNECTICUT: running brook, Vernon, June 15, 1932, *C. C. Hanmer*. NEW JERSEY: Peters Valley, Sussex Co., June 1, 1895, *Van Sickle* (U.S.). PENNSYLVANIA: without statement of locality or collector, U.S. no. 809. MINNESOTA: Vermillion Lake, *Sandberg*, no. 475 (U.S.). SOUTH DAKOTA: Merritt Ranger Station, Black Hills National Forest, *Murdoch*, no. 4312; Black Hills, near Ft. Meade, *Forwood*, no. 342 (U.S.). ALBERTA: prairie ponds, Castle Hill District, *Marion E. Moodie*, no. 1134 (U.S.); south of Castor, Stettler District, *Brinkman*, no. 2404 (U.S.), an intermediate form between *R. subrigidus* and *R. trichophyllus*. MONTANA: Rattlesnake, Missoula, *Kirkwood*, no. 1123; Jack Creek Canon, *Rydberg & Bessey*, no. 4135; Cliff Lake, Madison Co., *Rydberg & Bessey*, no. 4133; Swift Current Lake, McDermott, *B. Maguire*, no. 767; Big Fork, Flathead Lake, July 15, 1908, *Mrs. Joseph Clemens*; along Swift Current Creek, below Lake McDermott, Glacier National Park, nos. 16876 & 17430 (U.S.); sloughs, Midvale, *Umbach*, no. 218 (U.S.); Rost (?) Lake, *MacDougal*, no. 674 (U.S.); Flathead Plains, *MacDougal*, no. 456 (U.S.), transitional to var. *hispidulus*; Gallatin River, *Blankinship*, no. 15 (U.S.); Drummond, July 16, 1901, *Scheuber* (U.S.); vicinity of Snyder Lake and along Snyder Creek, Glacier National Park, *Standley*, no. 17959 (U.S.); Gallatin Valley, near

Bozeman, *Flodman*, no. 481 (U.S.); Bigfork, *M. E. Jones*, no. 7997 (U.S.). IDAHO: near Lakeview, Kootenai Co., Aug. 1-10, 1892, *Heller*; Hope, Lake Pend d'Oreille, *Sandberg, MacDougal & Heller*, no. 934; forks of St. Mary's River, *Leiberg*, no. 1169, transitional to var. *hispidulus*; ponds at Lapwai Agency, Nez Perces Co., *Sandberg, MacDougal & Heller*, no. 131; Tamarack, Washington Co., *June A. Clark*, no. 174; St. Anthony, *Merrill & Wilcox*, no. 858; Willow Creek, Big Camas Prairie, *Henderson*, no. 3371 (U.S.); valley of Traill River, Kootenai Co., *Sandberg, MacDougal & Heller*, no. 882 (U.S.); Lewiston, Nez Perces Co., *Heller*, no. 3142 (U.S.); near Moscow, June 21, 1894, *Henderson* (U.S.); small pond Cougar Gulch, Coeur D'Alene, *H. J. Rust*, no. 393 (U.S.); Goose Cr., Washington Co., *M. E. Jones*, no. 6137 (U.S.). WYOMING: warm waters of Nez Perces Creek, Yellowstone Park, *Nelson*, no. 6251; Hawks Ranch, twenty-five miles south of Laramie, July 2, 1918, *Churchill*; Soda Butte, *A. & E. Nelson*, no. 5860; Kendall, Sublette Co., *E. B. & L. B. Payson*, no. 2935; Gardiner River, Yellowstone Park, July 26, 1888, *F. H. Knowlton* (U.S.); Norris Geyser Basin, Yellowstone Nat. Park, *Mearns*, no. 3030 (U.S.); Yellowstone Lake, *Tweedy*, no. 906 (U.S.); Glen Creek, Swan Lake, *Mearns*, no. 2903 (U.S.); Plumbago Canon, Aug. 26-27, 1899, *Schuchert* (U.S.). COLORADO: below Carson, Gunnison Watershed, *Baker*, no. 320; Lake Creek, *Wolf & Rothrock*, no. 115; in shallow water, Buena Vista, Chaffee Co., *Biltmore Herbarium Colo. Exped.*, no. 3230a (U.S.); Steamboat Springs, *Shear & Bessey*, no. 4034 (U.S.); in Grand Lake, *Shear & Bessey*, no. 3986 (U.S.). UTAH: Wasatch Mts., *S. Watson*, no. 14; in pond, Aspen Zone, Twelve Mile Canon, Wasatch Mts., *Tidestrom*, no. 515 (U.S.). NEVADA: Ruby Valley, *S. Watson*, no. 14; Truckee River, Reno, *Tidestrom*, no. 10600 (U.S.); Battle Mountain, *A. E. Hitchcock*, no. 589 (U.S.). NEW MEXICO: Chusca Mts., San Juan Co., *A. Wetmore*, no. 532 (U.S.); Rio de las Casas, *Arsène*, no. 19161 (U.S.); Navajo Indian Reservation, in the Tunitcha Mts., *Standley*, no. 7601 (U.S.); Taos, Aug. 8, 1910, *Wootton* (U.S.). ARIZONA: Little Colorado River, *Goodding*, no. 643; Verde Valley, July 28, 1891, *MacDougal* (U.S.). CALIFORNIA: Big Manachi Meadows, *Rothrock*, no. 304; Claremont, Mar. 11, 1896, *Jepson*; Sierra Co., *Lemmon*, no. 3; Bartlett Springs, *Mrs. A. McCallum*; Deer Park, Lake Tahoe Region, *Eastwood*, no. 454; ponds at 1500 ft., Mt. Diablo, *Hall*, no. 1743; Presidio, San Francisco Co., *Michener & Bioletti*, no. 162; Susanville, June 29, 1897, *M. E. Jones*; Sacramento Valley about 5 miles northwest of Hamilton on the road to Orland, Glenn Co., *Heller*, no. 11348; valley of Trinity River near mouth of Willow Creek, Humboldt Co., *J. P. Tracy*, no. 3486 (U.S.); Pine Ridge, Fresno Co., *Hall & Chandler*, no. 328 (U.S.); near Sonoma, *Brewer*, no. 970 (U.S.); Mt. Shasta, Siskiyou Co., July 1-15, 1897, *H. E. Brown* (U.S.); Talmadge's Meadow, San Bernardino Co., *Parish*, no. 3397 (U.S.); Feather River, Plumas Co., June 1878, *Mrs. R. M. Austin* (U.S.); near Three Rivers, Tulare Co., *Coville & Funston*, no. 1208 (U.S.); Cabot Meadow, Stanislaus Forest,

Alpine Co., *Eggleston*, no. 9688 (U.S.); Waverley, *J. A. Sanford*, no. 359 (U.S.); Mt. Diablo, Contra Costa Co., *Elmer*, no. 4318 (U.S.); foot of Bloody Canon, Mono Co., July 19, 1889, *Chestnut & Drew* (Cal.); Laguna, *Cleveland*, no. 328 (Cal.); Snow Mt., Lake Co., June-Aug. 1892, *Mr. & Mrs. T. S. Brandegee* (Cal.); Noble Mine, San Diego Co., *Chandler*, no. 5502 (Cal.); small pools, Garner Ranch, Hemet Valley, San Jacinto Mts., *Munz & Johnston*, no. 5522 (Cal.); shallow pools near east end of lake, Bear Valley, San Bernadino Mts., *Munz*, no. 5706 (Cal.); Pilarcitos Lake and Canon, San Mateo Co., *Davy*, no. 1130 (Cal.); Medicine Lake, Siskiyou Co., *M. S. Baker*, no. 470 (Cal.); Laynes Ranch, April 29, 1909, *K. Brandegee* (Cal.). OREGON: in Des Chutes River, Lapine, Crook Co., *Peck*, no. 9626; Farewell Bend, Crook Co., *Leiberg*, no. 451; east side Harney Valley, *Leiberg*, no. 2372; Multnomah Co., *T. J. Howell*, no. 5; in a pool near Minam River, *Sheldon*, no. 8750 (U.S.); in a sluggish stream near Enterprise, Wallowa Co., *Cusick*, no. 2259 (U.S.); Yamhil Co., *Mrs. B. W. Summers*, U.S. no. 1,391, 372; vicinity of Laidlaw, Crook Co., *Whited*, no. 3067 (U.S.); near Wimer, Jackson Co., *E. W. Hammond*, no. 7 (U.S.). WASHINGTON: Waitsburg, *Horner*, no. 41 (U.S.); near Rock Ck., Spokane Co., *Sandberg & Leiberg*, no. 90, transitional to var. *hispidulus*; Harrington, Lincoln Co., *Sandberg & Leiberg*, no. 320; in slow streams, Falcon Valley, *Suksdorf*, no. 1960, transitional to var. *hispidulus*; Lake Ozette, Clallam Co., *J. W. Thompson*, no. 9420; "Box Canon," Pend d'Oreille River, *Kreager*, no. 395; Tacoma, May 1, 1908, *A. B. Leckenby* (U.S.); Lake Chelan, *Gorman*, no. 785 (U.S.); Ellensburg, *Whited*, no. 325 (U.S.); Lake Kachess, Kittitas Co., July 10, 1900, *H. D. Langville* (U.S.); Pend d'Oreille River, 1861, *Lyall*. BRITISH COLUMBIA: near mouth of Downie Creek, *J. M. Macoun*, no. 1129; Salt Spring Island, May 10, 1889, *J. Macoun*; Spencer Bridge, May 28, 1889, *J. M. Macoun*, transitional to var. *hispidulus*; Cameron Lake, Vancouver Isl., *Carter*, no. 220; Sproat Lake Falls, Alberni, Vancouver Isl., May 26, 1917, *Carter*, approaching var. *hispidulus*; near mouth of Downie Creek, *Shaw*, no. 1129 (U.S.); lower Frazer River, 49° N. Lat., 1859, *Lyall*. ALASKA: Attu Isl., Aug. 29, 1891, *J. M. Macoun*; Atka Isl., Aug. 26, 1873, *U. S. Coast Survey*; Iliuliuk, Unalaska, 1871-1873, *U. S. Coast Survey*; Iliuliuk, Unalaska, 1871-1872, *M. W. Harrington*; Izembek Bay, Hazen Pt., *Murie*, no. 18; Iliuliuk, Unalaska, *Jepson*, no. 317; near center of W. Boundary of McKinley National Park, *Mexia*, no. 2198 (Cal.). LOWER CALIFORNIA: San Pedro Martir, May 13, 1893, *Brandegee* (Cal.); mts., northern Lower California, *Orcutt*, no. 501 (U.S.).

The majority of authors who prefer more recent names than *Ranunculus trichophyllus* Chaix base their arguments on the assumption that Chaix's species is little else than a *nomen nudum*. Chaix's publication is as follows: "*trichophyllus* (mihi) Hall. 1162: in rivulis limpidis, Valgaud. Devoluy." It is true that Chaix himself gave no original diagnosis; but there is a definite reference to "Hall. 1162."

This, obviously, refers to Haller, *Historia Stirpium Indigenarum Helvetiae Inchoata*, ii. 69, n. 1162 (1768). To establish first what Haller was dealing with and at the same time to identify Chaix's species which was based upon it, it is necessary to study Haller's description, which follows:

1162. RANUNCULUS caule fluitante, petiolis unifloris, foliis capillaribus, laciniis divergentibus.

Foeniculum aquaticum, tertium TABERNAEMONT. p. 71.

Ranunculus trichophyllos, aquaticus, medio luteus COLUMN. *ecphras.* p. 315. 316. *Ranunculus aquaticus, albus, Foeniculi folio* BARRELIER. *ic.* 566. Frequentissimus in rivulis quietis, fossisque aqua plenis. A priori 1161 differt flore minori, foliis nulla quidem certa figura circumscriptis, multo tamen brevioribus, divergentibus. Flos similis: tuba maxima.

β *Foeniculum aquaticum, cornutum* C. B. *Prodr.* p. 73. J. B. III. p. 784.

Ranunculus aquaticus, albus, circinnatus, tenuissime divisis foliis, floribus ex alis longis pediculis innixis PLUKNET. p. 311. t. 55. f. 2. Circa Nidau, Erlach, Mathod, in fossis quietis. J. B. *Genevae*, C. B. in stagnis prope Hiltelingen.

Priori proximus, folia habet a caule parum recedentia, omnino circulari circumscriptione terminata, lobis densissime congestis, imbricatis. Nolui tamen a 1162 separare.

Unfortunately for clarity's sake, Chaix did not definitely state that, although Haller's no. 1162 included a variety β, he was referring to the "α" variety. Only by inference can it be established that Chaix was referring to the latter under no. 1162, since a reference to a given plant which has one or more varieties is customarily interpreted as applying to the first element. Haller's var. β is quite obviously *Ranunculus circinnatus* Sibth., because the reference to Plukenet's plate is also cited by Sibthorp¹ in the original description of *R. circinnatus*. Thus, Chaix actually referred to two quite different species. However, it is possible to establish the identity of Haller's var. α, since he cites as synonymous *Ranunculus trichophyllon aquaticus medio luteus* Col. *Ecphr.* i. 315, t. 316, which, in turn, was listed by Linnaeus under his var. γ. Moreover, the common dissected-leaved plant of Switzerland, whence Haller's typical form of the species came, is that passing as *R. trichophyllus* Chaix, according to Schinz and Keller.² Furthermore, *R. trichophyllus* Chaix has been maintained by the majority of European authors as the name for this species, so that it would seem more reasonable to retain it because of its general usage than to discard it as a *nomen confusum*.

¹ Fl. Oxon. 176, n. 503 (1794).

² Flora Schweiz, i. 203 (1905).

In this case the sound doctrine of the International Rules of Botanical Nomenclature, "where the consequences of rules are doubtful, established custom becomes law" (Art. 5), surely supports the retention of *R. trichophyllus* in its accepted meaning.

I cannot agree, then, with Williams,¹ who states that there would not have been any obscurity as to the identity of Chaix's plant had the latter referred definitely to Haller's earlier work² as Linnaeus does under var. γ : Haller, though setting off a var. β which is certainly what Sibthorp later described as *Ranunculus circinatus*, included under his typical form exactly the same synonyms cited in the previous publication.

With the conception of *Ranunculus trichophyllus* established to exclude *R. Drouetii* F. Schultz and its synonyms, but to include those forms which, in North America, have dilated floating leaves, it is now necessary to determine which plants should be reduced to *R. trichophyllus*.

Ranunculus aquatilis L., var. γ ³ was set off by Linnaeus from the rest of his *R. aquatilis* as a small-flowered form bearing only immersed, dissected foliage which was not of the circinate type. There are now known at least two distinct European species which might have been intended by the Linnean var. γ ; but, since the var. γ has not been made the basis of a later-published species, its exact identity does not seem to be of special importance. *R. foeniculaceus* Gilib.⁴ was a name accompanied by such an incomplete diagnosis (fide Williams, p. 14 l. c.) that it might apply to *R. trichophyllus*, *R. Drouetii* or *R. circinatus*, although Rouy & Foucaud, in their Flore de France, i. 70 (1893), employed it to supersede *R. circinatus* Sibth., a procedure which had no justification because of the vagueness of Gilibert's description.

Ranunculus divaricatus Schrank,⁵ described from Bavaria, is not clearly identifiable. Besides giving a brief and inconclusive diagnosis, Schrank cited as synonyms Haller's no. 1162, which was the basis of *R. trichophyllus*, and a plate of Tabernaemontanus,⁶ which was a very poor illustration of something which might have been *R. Drouetii*. Williams, selecting the plate of Tabernaemontanus as the primary basis of Schrank's species, takes up *R. divaricatus* for a species distinct from *R. trichophyllus*. There seems to be no justification for

¹ F. N. Williams, Journ. Bot. xlvi. 14 (1908).

² Enumeratio Methodica Stirpium Helvetiae Indigenarum, i. 328, no. 17 (1742).

³ Sp. Pl. i. 556 (1753).

⁴ Fl. Lithuan. iv. 261, n. 177 (1762).

⁵ Baierische Fl. ii. 104, no. 859 (1789).

⁶ Neuw Kreuterb. 187 (1664).

selecting the plate of Tabernaemontanus to stand primarily for *R. divaricatus*. It shows only the habit, without any of the important diagnostic characters, but it was possibly not the same as *R. trichophyllus*. Beck von Mannagetta,¹ unlike many others in Europe, treats *R. divaricatus* (1789) as doubtfully identical with *R. circinatus* (1794), but too doubtful to displace the later and clearly identifiable *R. circinatus*. Among the important botanists who treated *R. divaricatus* as apparently identical with *R. circinnatus*, there may be mentioned Wimmer, Fl. Schlesien, 9 (1835); Koch, Syn. Fl. Germ. i. 12 (1837); Grenier & Godron, Fl. France, i. 25 (1847); Ascherson, Fl. Brandenb. i. 12 (1864); and Suringar, Ned. Kruid. Arch. ser. 2, vi. 386-423 (1895). Since, of the various species to which the name *R. divaricatus* has been applied only *R. trichophyllus* is American, it is obvious that its exact typification, should that seem important, is a European problem. Certain American botanists have, however, complicated matters by employing the name *R. divaricatus*, itself only doubtfully belonging to the strictly European *R. circinatus*, for a North American plant with circinate leaves which appears to be distinct from the Old World species. Thus, for example, Britton & Brown in the first edition of their Illustrated Flora of the Northern United States and Canada (1897) included *Batrachium divaricatum* (Schränk) Wimm. as an American plant; and many other authors have followed this interpretation.

Ranunculus flaccidus Pers. and *R. rigidus* Pers.² were proposed as specific segregates from *R. aquatilis* L., as treated by Leysser.³ Persoon did not cite the synonymy for these plants, merely stating in his letter to Usteri, "Die weitläufigern Beschreibungen mit den Synonymien von diesen und von einigen anderen, mit den hiezu nöthigen Abbildungen, bekommen Sie zu einer anderen Zeit." However, referring to the *R. aquatilis* of Leysser's Flora Halensis, 136-137 (1783), it is found that Leysser treated two varieties, α and β , of the species. Variety α was based on Plukenet's plate,⁴ which Sibthorp cited in the original publication of his *R. circinatus*. Variety β , of Leysser's *R. aquatilis*, was the *R. trichophyllus aquaticus medio luteus* Colonna, Ecphr. i. 315. t. 316, which formed the basis of Haller's no. 1162, var. α , and therefore of Chaix's *R. trichophyllus*. Persoon did not actually state with which variety of Leysser's *R. aquatilis* his

¹ Fl. v. Nied.-Österreich, i. 414 (1890).

² Pers. in Usteri, Ann. d. Bot. xiv. 38-39 (1795).

³ Fl. Halensis, 136-137 (1783).

⁴ Pluk. Op. i. Phytograph. tab. 55, f. 2 (1691).

R. flaccidus and *R. rigidus* belong. From Persoon's description of *R. rigidus*, "foliis omnibus incis: laciniis rigidis utrinque compressis, reniformiter divergentibus.", it is apparent that it corresponded to Leysser's *R. aquatilis* var. α . *R. flaccidus*, consequently, was equivalent to Leysser's *R. aquatilis* var. β . Turning to Persoon's Synopsis Plantarum, 105 (1807), it is found that he there included *R. capillaceus* and *R. rigidus*, but no *R. flaccidus*. The description of *R. flaccidus* (1795) and the later *R. capillaceus* (1800) correspond very closely, so that it is reasonable to assume that Persoon intended *R. capillaceus* to supplant *R. flaccidus* as the name for his plant. Thus it is apparent that *R. flaccidus* (as well as the later *R. capillaceus*) is synonymous with *R. trichophyllus*, since Persoon's species was based on the variety β of *R. aquatilis* L., as treated by Leysser, which, in turn, was founded upon *R. trichophyllus aquaticus medio luteus* of Colonna, the basis of Haller's no. 1162 (var. α), and therefore Chaix's *R. trichophyllus*. *R. rigidus* (1795), however, is plainly synonymous with the earlier *R. circinatus* (1794), because of the citation of Plukenet's plate in the descriptions of both plants.

Ranunculus flaccidus Pers. was employed by Asa Gray in the Synoptical Flora of North America, as a variety under his *R. aquatilis* L. *R. aquatilis*, var. *flaccidus* Gray was the common dissected-leaved plant of New England, characterized by its long and few-segmented foliage. Gray's plant was probably identical with my *R. trichophyllus*, var. *calvescens*, which is found chiefly in New England.

Ranunculus cespitosus Thuill. (l. c.), appears, from Thuillier's description, to be a mud-form of some dissected-leaved species, the identity of which is not certain. According to Hiern, *R. cespitosus* might belong to *R. trichophyllus*, *R. Drouetii*, *R. circinatus*, or *R. fluitans*. DeCandolle, however, in his Systema, made *Ranunculus cespitosus* Thuill. a variety (β *caespitosus*) of his *R. pantothrix*. From the description of this plant and from the citation of such synonyms as *R. aquaticus albus circinnatis tenuissimè divisis foliis* Pluk. Alm. 311, t. 55, f. 2, *R.* no. 1162, var. β Haller and *R. rigidus* Pers. (all of which are synonymous with *R. circinatus* Sibth.), it is clear that DeCandolle intended his *R. pantothrix*, β *caespitosus* for the species now generally interpreted in Europe as *R. circinatus* Sibth. In the later Prodromus treatment, DeCandolle included all the species of the group, save *R. hederaceus* and *R. tripartitus*, under *R. aquatilis* L. Thus *R. pantothrix*, β *caespitosus* of the Systema becomes *R. aquatilis*, γ *caespitosus* of the Prodromus arrangement. Although the

synonymy of *R. aquatilis*, γ *caespitosus* is somewhat reduced, it is plain from the cited synonyms and the description, that DeCandolle's plant was, also, the same as Sibthorp's *R. circinatus*. The Prodrromus treatment is important to North American botanists, since several early students of our floras closely followed DeCandolle. Thus, Torrey & Gray, in the Flora of North America, i. 16 (1838), which was, to use Gray's own words, "hastily compiled," followed the Prodrromus arrangement very closely, so that DeCandolle's *R. aquatilis*, γ *caespitosus* (the plant now passing in Europe as *R. circinatus* Sibth.) was included as a member of our flora. Later (1895), Asa Gray,¹ largely drawing upon the conclusions of Hiern,² treated *R. aquatilis*, var. *caespitosus* DC. as a "dwarf and condensed form" (under *R. aquatilis* L., and not under *R. circinatus* Sibth. with which DeCandolle's *R. aquatilis*, γ *caespitosus* was identical). Piper,³ too, has taken up DeCandolle's *R. aquatilis*, γ *caespitosus*, apparently in the same sense as Gray. Just how Hiern reached his conclusions as to the nature of Thuillier's *R. cespitosus* I am not certain. It is evident, however, that at least DeCandolle's *R. aquatilis*, γ *caespitosus* was actually the species now passing as *R. circinatus* Sibth., a strictly European plant.

Thuillier also described a *Ranunculus capillaceus* which appears to have little significance, since it was founded on Haller's no. 1162, the basis for *R. trichophyllus* Chaix. Several years later, in his Systema (1817), DeCandolle took up *R. capillaceus* Thuill. as a variety α of his *R. pantothrix*. DeCandolle evidently considered *R. pantothrix*, α *capillaceus* the same as *R. trichophyllus*, since included in the synonymy of the former was Haller's no. 1162 (var. α), as well as *R. trichophyllus* itself. In the Prodrromus arrangement, DeCandolle transferred *R. pantothrix*, α *capillaceus* of the Systema treatment to *R. aquatilis*, α *capillaceus*, which is also clearly synonymous with *R. trichophyllus*.

In the seventh edition of Gray's Manual, 394 (1908), DeCandolle's *Ranunculus aquatilis*, β *capillaceus* was taken up instead of *R. trichophyllus* for the common dissected-leaved plant of the northeastern United States. It therefore included typical *R. trichophyllus* and var. *calvescens*.

Ranunculus paucistamineus Tausch⁴ was originally described from a Bohemian plant. Although I have not examined the type, I have

¹ Synop. Fl. No. Am. i. 21 (1895).

² Journ. Bot. ix. 100 (1871).

³ Fl. Wash., Cont. U. S. Nat'l. Herb. xi. 270 (1906).

⁴ Flora, xvii. 525 (1834).

been fortunate enough to be able to study an authentic Bohemian specimen of *R. paucistamineus*, named by J. Freyn,¹ which is in the Gray Herbarium. The plant differs at once from *R. trichophyllus* in the elongate fruiting peduncles, the many small achenes crowded upon an elongate (3 mm.) receptacle, and the large, flaring, stipular sheaths. The fruiting characters would hardly place the plant with *R. aquatilis* L., as Freyn maintains, since they are of the *R. circinatus*, *R. Baudotii*, and *R. marinus* circle of affinity. All of these species have elongate fruiting peduncles, many rather small achenes (± 1.25 mm.), a long receptacle (± 3 mm.), and large, well developed stipular sheaths, unlike typical *R. trichophyllus*. I do not propose to go further, at this time, into the relations of these European plants. Suffice it to point out that probably *R. paucistamineus* is not exactly identical with *R. trichophyllus*, as Freyn himself has stated.²

It is therefore doubtful if the course followed by Gelert,³ the Danish monographer, in regarding *R. paucistamineus* as not only including *R. trichophyllus*, but also *R. diversifolius* Schrank, was justified. Gelert is followed, however, by Lindman in his *Svensk. Fanerogamflora*, 264–265 (1918). Somewhat different is the view held by Pearsall, who maintains that *R. paucistamineus* is an aggregate species of wide range, including *R. Drouetii*, *R. trichophyllus*, and “even larger forms of our (*R. heterophyllus*) var. *submersus* so long as the flowers are not too large.” For the present *R. paucistamineus* as described by Tausch and distributed by Freyn in his *Flora Exsicc. Austro-Hung.*, will be regarded as something quite different from typical *R. trichophyllus*; but, in the sense of Hiern, or Pearsall, *R. paucistamineus* is in part referable to *R. trichophyllus*. Until the type can be examined, if it still exists, I do not feel that *R. paucistamineus* can be finally referred to *R. trichophyllus*.

Ranunculus aquatilis L., var. *Drouetii* (Schultz) Lawson, as treated by Lawson,⁴ was probably a slender form of our typical *R. trichophyllus* (or else the northern *R. trichophyllus* var. *eradicatus*). I have not been able to differentiate clearly among our plants *R. Drouetii* of Europe. The common dissected-leaved plant of the Cascade Mountains, British Columbia, and the Aleutian Islands is typical *R. trichophyllus*, though its northern variety *eradicatus* is also found in Alaska.

Ranunculus aquatilis L., var. *brachypus* Hook & Arn.⁵ was described

¹ Fl. Exsicc. Aust.-Hung., J. Freyn no. 95.

² Freyn, J., Beil. Bot. Centralbl. vi. no. 26: 1 (1881).

³ Bot. Tidsskr. xix. 26–29 (1894).

⁴ Trans. Roy. Soc. Can. ii. sect. iv, 45–46 (1884).

⁵ Bot. Beech. Voy. pt. 7; California-Suppl. 316 (1840).

from a Californian plant which had peduncles invariably shorter (less than one inch long) than the leaves, which, in turn, were divaricate. After examining many Californian *Batrachia*, I can find no basis for maintaining this state as a variety.

*Batrachium Bakeri*¹ and *B. pedunculare*² of Greene appear to be two atypical forms of the common *R. trichophyllum*; the fundamental floral and fruiting characters of the plants are nearly identical. Moreover, various plants of *R. trichophyllum* can be recognized which show foliage transitional to *B. Bakeri* and *B. pedunculare*.

Dr. Pennell and Dr. Merrill have kindly lent me the type material of *Ranunculus Porteri* Britton.³ An examination of the specimen in the Herbarium of the New York Botanical Garden showed a plant with unique, narrowly wedge-shaped foliage unlike any other *Batrachium*. Upon studying the other material, from the Herbarium of the Philadelphia Academy of Sciences, I found that of the three fragments there preserved the one bearing a flower bud had foliage of the normal, long, filiform type usually associated with *R. trichophyllum*. I am inclined to believe, then, in the absence of other plants bearing the peculiar foliage and because at least one fragment bears the nearly normal foliage of typical *R. trichophyllum*, that *R. Porteri* is an aberrant form of *R. trichophyllum*.

In his Manual of the Flowering Plants of California, Jepson (l. c.) reduces *Batrachium Bakeri* and *B. pedunculare* of Greene to varieties under his *Ranunculus aquatilis*. This arrangement was a step in the right direction, though it is doubtful if Greene's so-called "species" are anything more than local forms.

Finally, mention should be made of certain plants from southern California⁴ which appear to be referable to *Ranunculus Rionii* Lager, a species chiefly found in Europe, though certain plants in the Gray Herbarium from eastern Asia also seem referable to it. *R. Rionii* is characterized by small flowers, short-petioled flaccid leaves, and many very small achenes (± 1 mm. long). Whether the Californian plants which I am tentatively referring to this species are introduced or not, I am in no position to decide. Further studies, especially in the field, are necessary to determine this point. For the present, then, it will suffice merely to show that plants have been recognized in North

¹ Leaflets Bot. Obs. & Crit. i. 95 (1904).

² Leaflets Bot. Obs. & Crit. loc. cit.

³ Bull. Torr. Bot. Club, xvii. 310 (1890).

⁴ California: small branch of Chino Creek, 5 miles northwest of Corona, Riverside Co., Munz, no. 5022 (Cal.); sluggish brook east of Puddingstone Canyon, San Dimas, Los Angeles Co., Munz, no. 5601 (Cal.); Lemmon Herb., Cal. no. 338,356.

America which appear to be referable to the chiefly European *R. Rionii*, which, in turn, is closely related to *R. trichophyllus*.

4. *R. TRICHOPHYLLUS* Chaix, var. **hispidulus** (E. R. Drew), comb. nov. Plants with emersed, dilated floating leaves; their lobes 3–5, acute or obtuse-rounded at the tips and variously subdivided: floral and fruiting characters as in typical *R. trichophyllus*.—*R. hydrocharis* Spenn., forma *trichophyllus* (Chaix) Hiern, Journ. Bot. ix. 101 (1871), in part. *R. aquatilis* L., “form *heterophyllus*” Gray, Rev. No. Am. Ranunc., Proc. Am. Acad. xxi. 363 (1886). *R. aquatilis* L., var. *hispidulus* E. R. Drew, Bull. Torr. Bot. Club, xvi. 150 (1889). *R. aquatilis* L., var. *heterophyllus* DC. sensu Gray, Synop. Fl. i. 21 (1895), non DC. *R. Grayanus* Freyn, Deutsch. Bot. Monatschr. viii. 179–180 (1890). *B. aquatile* Dumortier sensu Howell, Fl. Nw. Am. i. 13 (1897), non Dum. *B. aquatile* Wimm. sensu K. C. Davis, No. Am. Ranunculi, Minn. Bot. Studies ser. ii: pt. 3. 461 (1900), non Wimm. *R. aquatilis* L., var. *hispidulus* (E. R. Drew) Jepson, Man. Fl. Pl. Calif. 391 (1925). *R. aquatilis* L. sensu Jepson, loc. cit., in part, non L.—Plants chiefly of the West, ranging from California to Alaska, east to western Montana, Idaho, and northern Utah. The following plants are representative: MONTANA: Columbia Falls, *R. S. Williams*, no. 991 (U.S.). IDAHO: near Harrison, valley of Coeur d’Alene River, Kootenai Co., *Sandberg, MacDougall, & Heller*, no. 645; forks of the St. Mary’s River, *Leiberg*, no. 1169, at least as to the plant with dilated leaves. UTAH: near West Fork of Bear River, Summit Co., *E. B. & L. B. Payson*, no. 4848, distributed as *R. Grayanus* Freyn. CALIFORNIA: Prattville, alt. 4,500 ft., July 5, 1897, *M. E. Jones*; Plumas Co., 1873, *Mrs. M. E. P. Ames, Mrs. R. M. Austin*, sheet no. 135,580 (Cal.); eight miles north of Folsom, *Ramaley*, no. 11309 (Cal.); near summit of ridge between Van Duzen and Mad Rivers, on Dinsmore’s Ranch, *J. P. Tracey*, no. 4276 (Cal.), a form somewhat resembling a small *R. peltatus*; floating on water in meadows, Russian River, *Bolander*, no. 3869 (U.S.), distributed as *R. hederaceus* L.; Round Valley, Mendocino Co., 1898, *Westerman* (Cal.); Mad River, near Jarnigans, July 1, 1890, *W. W. Price* (Cal.); Hydesville, Humboldt Co., June 19, 1893, *Blankinship* (Cal.); pond by railroad near Ione, *Greene*, journey of 1889 (U.S.); one mile west of Keystone, Tuolumne Co., *Abrams*, no. 10063 (U.S.); shallow water, Cuyamaca Lake, *Munz & Harwood*, no. 7204. OREGON: Oregon, *E. Hall*, no. 4 and 4a; in ditches, Portland, 1881, *Henderson*; pool by roadside, Salem, *J. C. Nelson*, no. 1070; Guano Ranch, Lake Co., *Coville*, no. 608 (U.S.); in ditches, Woodburn, *Howell*, no. 1779 (U.S.); the Dalles, *Brandegee*, no. 606 (U.S.); in a pond on Walker’s Creek, Jackson Co., *Applegate*, no. 2333 (U.S.); Forest Grove, May, 1898, *Kirkwood* (U.S.); brooks near McMinville, *Mrs. R. W. Summers*, no. 5 (Cal.). WASHINGTON: on mud and in shallow water, Falcon Valley, Klickitat Co., *Suksdorf*, no. 10074; White Salmon, *Suksdorf*, no. 1879, a form close to *R. heterophyllus* Web.; in slow streams, Fal-

con Valley, May 28, 1892, *Suksdorf* (U.S.), transitional to *R. trichophyllus*; near Rock Ck., Spokane Co., *Sandberg & Leiberg*, no. 90 (Cal.); Walla Walla, *Brandege*, no. 606 (Cal.); Camano Is., June 1, 1895, *N. S. Gardner* (Cal.); Aghut, Chehalis Co., *Lamb*, no. 1261 (U.S.). BRITISH COLUMBIA: below Sproat Lake Falls, Alberni, July 1916, *Carter*, a form close to the European *R. lutarius* Bouvet; Victoria, May 18, 1895, *Pineo* (Cal.). ALASKA: Nagai Isl., Shumagins, Aug. 2, 1872, *Harrington*; Nagai Isl., Shumagins, Sept. 18, 1892, *Jas. M. Macoun*; neither of the last two seems to be exactly var. *hispidulus*, but, in the absence of clear diagnostic characters, it is perhaps better temporarily to place them here.

Though obviously closely related to certain European plants, this variety does not appear to be identical with any of them. It has most frequently been identified with *R. heterophyllus* Web. of the Old World.¹ Accordingly I have made an intensive taxonomical study, aided by the abundant material at the Kew Herbarium, on the relation of these two forms. In general, *R. heterophyllus* is much larger and coarser than the usual form of our plant. Accompanying this greater size is also a greater number of parts, as frequently in the petals and the stamens. Moreover, the average diameter of the flowers of *R. heterophyllus* is close to 2 cm., whereas the average for our plant is about 0.8 cm. However, only when many specimens are examined does this difference become clear-cut, since small forms of *R. heterophyllus* appear almost inseparable from the larger examples of our *R. trichophyllus*, var. *hispidulus*. Furthermore, the same difficulty arises with smaller specimens of *R. peltatus*. Furthermore, these European dilated-leaved species of the Old World *R. aquatilis* (s. s.) group, *R. heterophyllus* and *R. peltatus*, are there apparently easily separable from *R. trichophyllus*, which is regarded by such careful and authoritative students as Felix² and Pearsall as *never*—and they emphatically insist on this word *never*—developing dilated floating leaves. Except for its somewhat dilated leaves, however, our plant is very close to *R. trichophyllus*, and has been regarded as a form of it by Hiern³ and by Freyn.⁴ The closely related *R. radians*,

¹ From the North American material of *Batrachium* in the U. S. National Herbarium, Gray Herbarium, and Herbarium of the University of California, it appears that only one specimen can properly be called a member of the Old World *R. aquatilis* (s. s.) complex. This plant, collected in 1887 at South Hadley, Massachusetts, by A. Clark (U. S. no. 275,313), appears to be referable to the European *R. peltatus* Schrank. Inasmuch as no other specimens of this plant are to be found in the Herbaria cited above, which I have examined, it is probable that this plant of *R. peltatus* is a casual introduction into this country from Europe.

² Bull. Soc. Bot. France lx. 260 (1913).

³ Journ. Bot. ix. 101 (1871).

⁴ Deut. Bot. Monatschr. viii. 180 (1890).

R. Godronii and *R. Petiveri* of the European *R. trichophyllus*-plexus certainly develop dilated floating leaves, although typical *R. trichophyllus* itself does not. These species, though closely allied to *R. trichophyllus*, are apparently quite distinct one from the other. Such is not the case with our dilated-leaved plant which in its fundamental fruiting and floral structures seems inseparable from the *R. trichophyllus* of North America. The only consistent feature about it is its geographic distribution: apparently it is never found east of the Rocky Mountain states. It is doubtless better, then, to treat it as a geographic variety.

The first mention of our plant is found in Hiern's account of the "Forms and Distribution of *Batrachium*" (l. c.). Hiern simply stated that a form of his *Ranunculus hydrocharis* Spenn., forma *trichophyllus* with floating leaves occurs in California; but he gave this form no name. It seems very significant to me that Hiern, who was perhaps the best informed student of *Batrachia* from a world-wide point of view, should conclude that it was a form of *R. trichophyllus* and not a member of the *R. aquatilis* group (s. s.). Gray, in his revision of the North American *Ranunculi* (l. c.), merely stated that the form "heterophyllus" (the type of Linnaeus's *R. aquatilis*) was distributed from British America and North Alaska to California. He regarded it simply as a member of the *R. aquatilis* complex. A similar interpretation was maintained in the Synoptical Flora. The character upon which *Ranunculus aquatilis* L., var. *hispidulus* E. R. Drew was based, the pubescent under surfaces of the floating leaves and petioles, seems unimportant in view of the fact that such is the condition of normal specimens of the European *R. heterophyllus*, *R. peltatus*, and other dilated-leaved species. Although this variety of Drew's was based upon a weak character, the name which he assigned to it must be taken up, since it is the first one clearly and exclusively pertaining to our plant.

Ranunculus Grayanus Freyn is doubtless our western heterophyllous form of *R. trichophyllus* since it coincides with the latter in taxonomical characters and geographical distribution.¹ It is the correct name for the plant, if treated as a species, as is done by Rydberg and by Tidestrom.

¹ Freyn's opinion of the relation of *R. Grayanus* is significant. He writes in part, "*R. Grayanus* verhält sich zu *R. Godronii* Gren. genau so, wie der ägyptische *R. Aschersonii* m. zu dem Formenkreise des *R. Petiveri homophyllus* und deshalb habe ich die amerikanische Form neu benannt; sie gehört dem engeren Formenkreise des *R. paucistamineus* Tsch. an, nicht jenem des *R. aquatilis* L. p. p., wie ich dieselben in A. Kern. Sched. ad. flor. Austriac. v (1888) p. 38 skizziert habe."

Dr. Porsild,¹ in his studies on the West Greenland flora, has reported a *Batrachium* with dilated-floating leaves which he refers to *R. divaricatus* Schrank. Lacking material of Porsild's plant at the present time, it will be extremely interesting to determine at some future date whether this plant is one of the many European forms or if it is more closely related to our *R. trichophyllum*, var. *hispidulum*.

5. *R. TRICHOPHYLLUM* Chaix, var. **calvescens**, var. nov. (TAB. 383, FIGS. 8, 9). Var. *typico* similis; receptaculo glabro vel subglabro, acheniis maturis quam in var. *typico* longioribus (plerumque circa 1.5–1.75 mm., in var. *typico* 1–1.5 mm.) laevioribus semperque glabris. —The common form of New Brunswick and New England, south to Pennsylvania and west to Michigan. The following are typical: NEW BRUNSWICK: Bass River, July 27, 1875, *Fowler* (U.S.). NOVA SCOTIA: Shinimikas River, Northport, Cumberland Co., *Fassett*, no. 2250. MAINE: common in gravelly-bottomed streams, Dover, Sept. 1, 1894, *Fernald*, and same region, *Fernald* no. 240; dead water in the river, Milo, Sept. 2, 1897, *Fernald*; mouth of Penjajawock Brook, Bangor, *Fernald*, no. 2693; Dyer Brook, Island Falls, Aug. 28, 1897, *Fernald*; Woodstock, July, 1887, *Parlin*; Pennamaquan River, Pembroke, *Fernald*, no. 1776; clayey brook, Farmington, July 18, 1903, *Knowlton*; Sunkhaze Stream, Milford, July 23, 1892, *Fernald*; Cobossee Contee Lake, Winthrop, Aug. 1898, *T. J. Battey*; sluggish streams, Wells, June 16, 1894, *Parlin*; Hermon Pond, *Knight*, no. 4517; Sebasticook stream, Newport, *C. D. Harvey*, no. 15 (U.S.); shallow water of White's Brook, Seven Islands, Township xiii, Ranges 14 and 15, Aroostook Co., *St. John & Nichols*, no. 2292 (U.S.). NEW HAMPSHIRE: Bear Camp River, West Ossipee, Sept. 6, 1855, *W. Boott*; "Weare's Mill," Seabrook, *A. A. Eaton*, no. 33; East Jaffrey, July 6, 1889, *W. Deane* (U.S.). VERMONT: near Isle La Motte, Lake Champlain, July 19, 1878, *Pringle*; West Rutland, Aug. 25, 1895, *Eggleston*; totally submerged, south of Knights Island, Lake Champlain, July 21, 1899, *Brainerd*. MASSACHUSETTS: Cram's River, Danvers, July 2, 1885, *J. H. Sears* (TYPE in Gray Herb.), June 10, 1886 and July 5, 1896, *Sears*; brook in Walnut Grove, Danvers, June 10, 1886, *Sears*; brook, near Harrington's, Concord, July 12, 1887, *E. S. Hoar*; Blue Hill Reserv., Randolph, June 22, 1895, *J. R. Churchill*; Purgatory Brook, Norwood, June 17, 1895, *G. G. Kennedy*; Martin's Brook, North Reading, *Pease*, no. 2013; Hunt Place Brook, Randolph, Nov. 11, 1894, *G. G. Kennedy* (sterile); near Green Lodge, Dedham, *C. E. Faxon*; stream flowing into Ward Pond, Becket, July 11, 1909, *Hoffman*; slow stream, Richmond, June 24, 1901, *Hoffman*; West Boxford, *C. N. S. Horner*; stagnant pool, West Quincy, Sept. 3, 1894, *Rich*; brook in meadow, Sharon, July 12, 1896, *Rich*; cold brook, Dover, Sept. 2, 1889, *G. G. Kennedy*; Melrose, July 6, 1876, *Morong*; Mill Pond, North Saugus, *F. S. Collins*, no. 730; Southamp-

¹ Meddel. om Grönl. lviii. 77 (1926).

ton, 1892, *Chapman*, at least as to specimens on the right of the sheet (U.S.); Amherst, Aug. 2, 1881, *B. P. Clark* (B.U.); in brook, West Stoughton, *S. F. Blake*, no. 3682 (U.S.), transitional to var. *typicus*. RHODE ISLAND: Rush Brook Swamp, North Scituate, May 30, 1911, *Floyd & Preston*; Smithfield, *Thurber*. CONNECTICUT: Glastonbury, Aug. 15, 1903, *Driggs*; Beaver Brook, Milford, May 28, 1899, *E. H. Eames*; in running streams, Southington, *L. Andrews*, no. 766; Mianus River, Stamford, *Eames & Godfrey*, no. 8222; New Haven, *D. C. Eaton*; Somers, *Pease*, no. 583; in brooks, common, Southington, June 30, 1896, *Bissell*; small brook, near Dragon's Den, Franklin, June 28, 1905, *Graves*; brooks, common, Southington, *Bissell*, no. 47; Whetstone Brook, Killingly, July 2, 1903, *Knowlton*; brook, Warren, July 18, 1919, *Nichols*; Trout Creek Bridge, Franklin, July 10, 1906, *Woodward*; Bridgeport, June 23, 1885, *A. L. Winton, Jr.* (U.S.); shallow, slow-flowing water of stream, Redding, *Weatherby*, no. 5676 (U.S.). NEW YORK: cold brook near Cohasset on Fourth Lake, Herkimer Co., *House*, no. 6697, a form with achene unusually long-beaked. PENNSYLVANIA: frequent, Chester Co., June, 1858–1864, *S. P. Sharples*, sterile. MICHIGAN: Keweenaw Co., *Farwell*, no. 134.

Although var. *calvescens* is more typical of eastern North America, plants with glabrous achenes and nearly naked receptacles are occasionally found in the West. Usually, however, these western plants have definitely smaller achenes and smaller flowers than var. *calvescens*. Moreover, at the northern limits of its range in New Brunswick and northern Maine, var. *calvescens* makes transitions to typical *R. trichophyllus*; plants from northern Maine will often have few to several hairs on the receptacle, but they never show the densely pubescent condition of the typical form of the species.

6. *R. TRICHOPHYLLUS* Chaix, var. ***eradicatus*** (Laestadius), comb. nov. (FIG. 5). Plants with very slender, weak stems usually with many adventitious roots: leaves short, flaccid, filiformly dissected, petioled, with narrow, mostly adnate, hairy or nearly glabrous stipular sheaths: flowers small, 0.7–0.8 cm. in diameter: petals 3–6 (av. 5)-veined: stamens 5–10, varying in length according to their age: carpels 8–20 (usually 12–16), usually hairy when immature; achenes 1–1.5 mm. long, hairy or not, usually quite smooth, with a very short inconspicuous beak: receptacle 0.75–1.5 (av. 1) mm. long, variously shaped, almost invariably long-hairy.—*R. aquatilis* L., var. *eradicatus* Laestadius, N. Act. Reg. Soc. Scient. Ups. xi. 242 (1839). *Batrachium eradicatum* Fries, Bot. Notis. 114 (1843), name only. *B. confervoides* Fries, Bot. Notis. 121 (1845). *R. confervoides* Fries, Summa Veg. Scand. i. 139 (1846). *R. paucistamineus* Tausch, var. *borealis* Beurl. Bot. Notis. 156 (1852). *R. lutulentus* Song. & Perr. in Billot. Annot. Fl. Fr. et Allem. 181 (1859¹). *B. admixtum* Nyl.

¹ See discussion.

& Saell. Herb. Mus. Fenn. 35 (1859), acc. to F. N. Williams.¹ *R. aquatilis* L., γ . *saganensis* Regel et Radde, Regel, Bull. Soc. Nat. Mosc. xxxiv. pt. 2: 39 (1861). *R. hydrocharis* Spenn., forma *confervoides* (Fries) Hiern, Journ. Bot. ix. 102 (1871). *R. aquatilis* L., var. *confervoides* (Fries) Lawson, Rev. Can. Ranunc., Trans. Roy. Soc. Can. ii: sect. iv. 45 (1884). *R. trichophyllus* Chaix, var. *demersus* N. E. Brown, Eng. Bot. Suppl. 12 (1892), ed. 3, acc. to Williams. *R. divaricatus* Schrank, var. *eradicatus* (Laestad.) Williams, Journ. Bot. xlv. 21 (1908). *R. flaccidus* Pers., var. *confervoides* (Fries) Hegi, Illus. Fl. Mittel-Europ. iii. 584, fig. 708 k (1912).—Greenland, Labrador, Newfoundland, Quebec (Gaspé Peninsula, anticosti and James Bay); northern Wyoming; Alaska; northern Europe. The following specimens are referred here. GREENLAND: Egedesminde, lat. 67° 57' Syddistrikt, July 30, 1924, *A. E. Porsild*; Godhavn, lat. 69° 14', Sept. 10–20, 1920, *A. E. Porsild*; Queqertarssuag, Nûgâtsiaq, lat. 71° 33', July 16, 1929, *M. P. & R. T. Porsild*; Ingnerit Fjord, Magdlâq, lat. 71° 7', July 12–13, 1929, *M. P. & R. T. Porsild*; Tringa Pond, North Star Bay, lat. 76° 30', *Ekblaw*, nos. 341, 342 and 343. LABRADOR: pool in rocks, Near Island, Seven Islands Bay, Kangalaksiorvik, *Abbe*, no. 325; gneiss plain, Blanc Sablon, *Fernald & Wiegand*, no. 3406. NEWFOUNDLAND: open peat bogs among the Silurian hills back of Birchy Cove (Curling), *Fernald & Wiegand*, no. 3405; shallow pools, Eddie's Cove, Straits of Belle Isle, *Fernald, Wiegand, & Long*, no. 28,245; pond-holes and pools, Sacred Island, Straits of Belle Isle, *Wiegand, Gilbert & Hotchkiss*, no. 28,247; shallow pools in swampy clearings and thickets, Bard Harbor, St. John Bay, *Fernald & Long*, no. 28,246; peaty depressions in tundra, Schooner (or Brandy) Island, Pistolet Bay, *Pease & Long*, no. 28,244; shallow pools near Harry's River, *Fernald & Wiegand*, no. 3408, approaching *R. trichophyllus*, var. *typicus*; Quidy Viddy Lake, Aug. 2, 1894, *Robinson & Schrenk*; Exploits River, near mouth of Badger Brook, Aug. 13, 1894, *Robinson & Schrenk*. QUEBEC: stagnant water, Cape Chudleigh (Cape Chidley), Hudson Strait, Aug. 5, 1884, *R. Bell*; in shallow water, on granite rocks, Lac Perrée, Tabletop Mts., Gaspé Co., *Fernald, Dodge & Smith*, no. 25,755; alpine lake, Tabletop Mts., Gaspé Co., *Fernald & Collins*, no. 570; estuaire de la Rivière York, *Victorin, Rolland, Brunel & Rousseau*, no. 17,353; Rivière la Loutre, Anticosti, *Victorin & Rolland*, no. 25,444, doubtful. WYOMING: Swan Lake Flat, Yellowstone Park, *E. C. Smith*, no. 207 (U.S.), and *E. A. Mearns*, no. 2434 (U.S.), both doubtful. ALASKA: St. Paul Island, *J. M. Macoun*, no. 89,578.

The original description by Laestadius,² which was extremely detailed, is significant in evaluating the merit of subsequent treatments of this variety.³

¹ See discussion.

² N. Acta. Reg. Soc. Scient. Ups. xi. 242 (1839).

³ "2) *a. subaquaneus*, caule bi 1. 3-pollicari, filiformi; floribus minutissimis, ante explicationem vix semine cannabis majoribus; foliis non proprie capillaribus, sed

It is quite evident from Laestadius's remarks that he believed the filiform and diminutive habit of the plants to be due to ice-action in pulling up the roots so that the new growth arose from the fragments of the old. In other words, he regarded var. *eradicatus* as simply a variation, brought about by the rigors of a subarctic climate, of the usual dissected-leaved European *R. aquatilis*.

It was subsequently pointed out by Fries¹ that Laestadius was dealing with an abnormal state of the plant described by the former as *Batrachium confervoides*. In part Fries writes: "Collatis numerosis et perfectis speciminibus e varietatum numero excludendus omnino est *Ranunc. aquatilis eradicatus* Laest., qui abnormem quidem statum sistit (quare nomen varietatis ad speciem trahere non licet), sed ad speciem carpellis, β *tripartiti* Reich. Ic. f. 4574 figura exactissime respondentibus, et receptaculo cylindrico-conico diversissimam pertinet."

Thus Fries regarded the plant as a close relative of *R. tripartitus* rather than of *R. aquatilis* L. He was doubtless correct, since the fruit of *R. tripartitus* as depicted in the plate² referred to, which closely matched that of *R. confervoides*, is certainly not to be confused with that of *R. aquatilis* L. (s. s.), in which the achenes are larger, more pointed and frequently bear hairs. Whether or not the plant of Laestadius was abnormal, one can hardly say without examination of the original specimen which Fries had evidently studied. It is noteworthy in this connection, however, that the great majority of authentically named specimens of *R. confervoides* possess adventitious roots at many of the nodes, which would indicate that to survive the severe climatic conditions to which they are subjected, the plants necessarily develop these organs, especially when broken off from their weak, primary fibrous roots. Moreover, many specimens exhibit deformed stems so that it is undoubtedly true that ice-action and stranding have an effect on the habit of the next year's growth. Thus perhaps the plant of Laestadius was not so very abnormal, but rather was more severely damaged than usual by ice-activity.

abbreviatis; radice filiformi, fibrosa. Hab. in stagnis vadosis ex. gr. Karavuopio et Saxajerfvi ad Karesuando Lappon. Tornensis. Caespitose crescit in fundo, quo etiam floret sub aqua, interstitio 3-pedali ex summitate plantae ad superficiem aquae. Aequae memorabilis et omnino constans varietas ac *Nymphaea pumila*, et pari modo orta. Glacies enim radices *Ranunculi aquatilis* funditus evellit; sed reliquiae i. e. *radiculae*, ipsae graciles, gracillimam edunt plantam; quae tali modo diminuta, praecox quoque facta est: Nam *Ranunculus aquatilis vulgaris* nondum explicavit flore, hujus fructibus jam maturis. *Ran. aquatilis* α , saepius in alto et in aqua manante nascitur; unde et serius floret, et folia valde elongata et eximie capillacea habet."

¹ Bot. Notis. 121 (1845).

² Reichenb. l. c.

At this point it is pertinent to discuss the characters upon which *Batrachium confervoides* Fries¹ was based, with a view to more clearly establishing its relation to the other *Batrachia*. The habital characters appear to be important, since the filiform, rather short leaf-segments and weak, slender stem are superficially quite different from those of normal specimens of the other European *Batrachia*. Few groups of plants, however, are as polymorphic in their habit, foliage, etc., as the *Batrachia*; and *R. confervoides* of all the aquatic, white-flowered *Ranunculi* has the most severe of environmental conditions. One would, therefore, expect plants of the same species under these conditions to be habitally different from others of their kind growing farther south. Little emphasis can be placed on such characters as specific distinctions unless they are associated with more fundamental differences. Fries's diagnosis is as follows: "Stamina 10-15, ovariorum capitula longiora. Receptaculum conico-cylindricum, longe hirsutum, cum carpellis globosum. Carpella obovato-turbinata, fere aequalia, extus acute carinata, omnino mutica, apice rotundato-obtuso, sursum primo hispidula, demum calva: diu laevia persistentia, ceterisque demum multo obsoletius transverse rugosa." Checking these characters with authentically named European material² I find that this diagnosis is essentially adequate. The carpels, however, are not always "sursum primo hispidulo" and glabrous at maturity. Careful study shows that the immature carpels are glabrous as often as they are hispidulous; and the mature achenes are pubescent and glabrous in nearly the same ratio. Consequently, little diagnostic importance can be attached to the presence or absence of hairs either on the immature or mature carpels.

The characters of *R. confervoides* which appear to be the more significant are as follows: first, the usually short leaves, and filiform stem: second, the many adventitious roots; and, third, the more or less smooth mature achenes. It seems entirely possible that *R. confervoides* is nothing but the northern form of the ordinary *R. trichophyllus*, the fundamental characters of which, with the possible exception of the smooth achenes, remain practically unobscured even though habital changes have altered the normal appearance. The smooth achenes seem to be the most significant character, but further

¹ Bot. Notis. l. c.

² a. In lacu Schwarzee dicto prope Zermatt, Helvetia, alt. 2500 M., F. Schultz, herb. norm., nov. ser. cent. 11, no. 1009.

b. Uleaborg; Finlandia, Dr. W. Nylander, Jun.

c. E. Lapponia Tornensis, L. L. Laestadius.

study of European material is needed to decide as to their constancy and diagnostic value. For the present *R. confervoides* is regarded in this paper as a northern variety, unfortunately not too well marked, of the ordinary European and North American *R. trichophyllus*.

Ranunculus aquatilis, var. *eradicatus* of Laestadius appears to be the earliest name applicable to our plant, even though Fries states that it was applied to a somewhat abnormal form. It does not seem to me, however, that Laestadius' name can be disregarded on the basis of the International Rules of Nomenclature, Art. 51 (no. 3), which states that a name can be rejected if based upon a monstrosity, since, from the description, it is hardly in the latter class. If, however, it should be shown from a first-hand examination of Laestadius' plant, that it may properly be considered a monstrosity, which seems unlikely, the name would have to be rejected.

Following these names comes *Ranunculus paucistamineus* Tausch, var. *borealis* Beurl.¹ which was founded on the earlier (1839) *Ranunculus aquatilis*, var. *eradicatus* of Laestadius; but *R. paucistamineus* by many botanists, including the writer, is regarded as synonymous, at least in part, with *R. trichophyllus* Chaix. Then, in 1859, *Ranunculus lutulentus* was published by Songeon and Perrier² as a new species characteristic of the higher altitudes (7000 feet) of Switzerland and Savoy. According to Hiern,³ who was apparently familiar with specimens of this plant, its habit approached that of *R. confervoides*. In Hiern's treatment, *R. lutulentus* is placed under *R. hydrocharis*, forma *Drouetii* which is extremely close to *R. trichophyllus*. Fortunately, I have been able to study authentic specimens of *R. lutulentus*, named by Perrier, which are in the Gray Herbarium.⁴ A careful check of the characters of this plant have brought out the following: flowers 0.8–1 cm. in diam.; petals mostly 5-veined, narrow; stamens 8–10; carpels 16, glabrous; mature achenes rugulose to rugose, rarely smooth, glabrous; leaves short, petiolate, with filiformly dissected segments; stipules small, hairy when young; receptacle hairy. The habit of the plant is perhaps slightly more robust than in *R. confervoides* Fries, but not conspicuously so. All specimens examined, however, gave no indication of the development of the many adventitious roots characteristic of *R. confervoides*.

¹ Bot. Notis. l. c.

² Billot, Annot, Fl. Fr. et Allem. l. c.

³ Journ. Bot. ix. 102 (1871).

⁴ a. "Étang de la forêt de Aut-du-pré, au mont Mirantin (Hte. Savoie) E. Perrier, fl. 8bre; fr. 16 jt. 1857."

b. Près Conflans (Savoie), E. Perrier.

With the exception, then, of a few more carpels, slightly more rugose achenes, and the absence of adventitive roots, *R. lutulentus* is nearly identical with typical *R. confervoides*. Indeed, in as far as it differs, it seems to be quite a natural transition to *R. trichophyllus*. Of these two, however, it is obviously closer to *R. confervoides*, and probably ought to be considered as a form of that plant, for it is scarcely worthy of independent varietal rank.

Batrachium admixtum Nylander & Saellan,¹ according to Williams, does not differ in any way from his *R. divaricatus*, var. *eradicatus*. Williams states that *B. admixtum* occurred with *B. confervoides* in the Limingo district of Finland. The chief distinction between *B. admixtum* and the latter species was in the "Folia longius petiolata," which is hardly an important character.

I have also been fortunate enough to be able to examine authentic specimens² of *Ranunculus aquatilis*, γ . *saganensis* Regel & Radde.³ A critical study of Radde's material has failed to show any conspicuous difference between it and *R. confervoides*. It is perhaps slightly more robust but otherwise it is practically identical with the exception of the rugose achenes. Here, as in the case of *R. lutulentus*, the plant is so close to *R. confervoides* that it scarcely seems possible to consider it as anything more than a form thereof. As a matter of fact, the importance of smooth achenes in *R. confervoides* is open to question since some of the European material⁴ in the Gray Herbarium bears fruit which is definitely rugulose or rugose.

Ranunculus trichophyllus var. *demersus* N. E. Brown was described from a Scottish specimen which Williams regards as true *R. confervoides*. The very complete description checks exceedingly well with *R. confervoides*, with the exception of no mention of adventive roots. It appears, then, that *Ranunculus trichophyllus*, var. *demersus* is simply a smaller and more slender form of that species, which closely approaches var. *eradicatus*. It is significant to note what Brown has to say further regarding his plant. In part he writes: "From the opinion expressed by Prof. Lange in 'Florae Danicae' Vol. xvi., fasciculus 47, p. 7, it would appear that he inclines to the belief that the Scandinavian *R. confervoides* is a variety of *R. Drouetii*, which also seems to me to be the case, whilst I cannot

¹ Herb. Mus. Fenn., l. c.

² In alpihus Sajanensis, ex herbario horti Petropolitani: leg. Radde.

³ Regel, l. c.

⁴ a. In flumina Konkumans, Lapponia enontekiensis, Iustus Montell, July 31, 1913 (rugose).

b. Uleåborg, Finlandia, Dr. W. Nylander, Jun. (smooth to rugulose).

specifically separate the Scotch plant from *R. trichophyllus*." It is thus probable that we are dealing here with a form of *R. trichophyllus* which very nearly approximates var. *eradicatus*.

Lawson, in his Review of the Canadian *Ranunculaceae*, took up the name *Ranunculus aquatilis* var. *confervoides* (Fries) Lawson for our plant. *R. aquatilis*, var. *eradicatus* of Laestadius was clearly an earlier name so that it should have taken precedence over *R. confervoides* Fries in Lawson's treatment. Apparently this study of the *Ranunculaceae* in North America was the first to include *R. trichophyllus*, var. *eradicatus* as a component of our flora.

Another combination was published by Williams as *Ranunculus divaricatus*, var. *eradicatus* (Laest.) Williams. This combination in effect crystallizes Lange's earlier opinion (above), since Williams' *R. divaricatus* is probably synonymous with *R. Drouetii* of later authors.

Similarly Hegi, in the Illustrated Flora of Mittel-Europa, iii. 584 (1912), regards *R. confervoides* as a variety of *R. flaccidus* Pers., *R. flaccidus*, var. *confervoides* (Fries) Hegi. However, this varietal combination seems unnecessary because of the priority of Laestadius' varietal name.

Gray did not mention this northern plant until the treatment in the Synoptical Flora where he also included it under *Ranunculus aquatilis* L., as variety *confervoides*.

7. *R. subrigidus*, sp. nov. (TAB. 406, FIGS. 1, 4, 10). Planta habitu *R. longirostri* similis; foliis omnibus submersis capillaceo-partitis circumscriptione fere orbiculatis subrigidis, foliis inferioribus subsessilibus vel petiolatis, superioribus sessilibus; stipulis villosis amplis tota longitudine petioli adnatis; floribus diametro 1–1.6 (plerumque 1.3–1.5) cm.; petalis 5–7-nerviis quam calyx subduplo longioribus; staminibus 10–22 (plerumque 15); carpellis 30–80 (av. 40) hirtis, stylo longitudine carpellam aequante; acheniis maturis 1–1.5 (av. 1.25) mm. longis glabris vel hirtis, rostello 0.1–0.5 (plerumque 0.25–0.3) mm. longo; receptaculo oblongo vel obovato 1–2.5 (plerumque 1.75–2) mm. longo piloso; caulibus immersis gracilibus plerumque elongatis; pedunculis quam folia plerumque longioribus.— Newfoundland and the Gaspé Peninsula of Quebec, south to western New England, where it is rare; west from Michigan to the Pacific, and south to northern Mexico. The following are representative: QUEBEC: dans les bras morts de Rivière Petite Cascapedia, *Victorin, Rolland & Jacques*, no. 33,337; York River, July 29, 1905, *Williams, Collins, & Fernald* (TYPE in Gray Herb.); between the Forks and Brûlé Brook, Little Cascapedia River, *Collins, Fernald & Pease*, no. 5007. VERMONT: Timmouth Creek, Timmouth, July 25, 1895,

Eggleston; Barnard Pond, Aug. 15, 1892, *Jesup & Sargent*; outlet of W. M. Evarts' Pond, Windsor, June 27, 1897, *Eggleston*; Mud Pond, Peacham, Aug. 2, 1884, *F. Blanchard* (U.S.). MASSACHUSETTS: Spring Brook Pond, Lanesboro, Berkshire Co., Aug. 15, 1916, *Churchill*. MICHIGAN: Liver-light Lakes, Iron Co., *F. P. Metcalf*, no. 2223 (U.S.). MANITOBA: along line of Grand Trunk Ry., *Sewell, Macoun & Herriot*, no. 69,788. MINNESOTA: Stay Lake, Lincoln Co., *F. P. Metcalf*, no. 1784 (U.S.); Swan Lake, Nicollet Co., *F. P. Metcalf*, no. 44 (U.S.); Muskeg Bay, Lake of the Woods, $\frac{1}{2}$ mile north of the mouth of Warroad River, Roseau Co., *Hotchkiss & Jones*, no. 412; Lake of Woods, Flag Island, *F. P. Metcalf*, no. 1534 (U.S.). NORTH DAKOTA: Wallace, north of Dawson, *F. P. Metcalf*, no. 303 (U.S.); Long Lake, McHenry, *D. C. Mabbott*, no. 349 (U.S.); Driscoll Lake, Napoleon, *F. P. Metcalf*, no. 206 (U.S.); slough 7 miles east of Bismark, *F. P. Metcalf*, no. 354 (U.S.); Leeds, Benson Co., July 13, 1908, *Lunell* (U.S.). SOUTH DAKOTA: creek northeast of Camp Crook, Harding Co., *Vischer*, no. 5 (U.S.); sloughs, Sanborn Co., *Over*, no. 13,814 (U.S.); Beaver Creek, Mayo, Custer Co., *Over*, no. 1742 (U.S.), a somewhat atypical form. TEXAS: Pecos River, Ft. Smith to the Rio Grande, *J. M. Bigelow*. ASSINIBOIA: Milk River Ridge, *Macoun*, no. 10,043 (U.S.); in pond on prairie, Parkby, June 10, 1905, *W. Palmer* (U.S.); Crane Lakes, June 16, 1894, *Macoun*. ALBERTA: Nab Pond, Wolf Creek, Craigmyle District, *Brinkman*, no. 594; Bow River Valley, *S. Brown*, no. 678 & 693; Calgary, *Macoun*, no. 18,043 (U.S.); Calgary, near Bow River, *M. A. Barber*, no. 221; Vermillion Lake, *McCalla*, no. 2120 (U.S.); small pond below hotel, Banff, *F. C. Prince*; Athabasca Landing, *A. B. Hitchcock*, no. 12,099 (U.S.). MONTANA: Ringling, Aug. 5, 1921, *Wooton* (U.S.); Cliff Lake, Madison Co., *Rydberg & Bessey*, no. 4133 (U.S.); Columbia Falls, June 2, 1894, *R. S. Williams*; near inlet, Two Medicine Lakes, *Maguire*, no. 760; Bigfork, *M. E. Jones*, no. 795 (U.S.). IDAHO: Henry's Lake, Fremont Co., *Nelson & Nelson*, no. 6799; Soda Springs, June 17, 1892, *Mulford*; Falk's Store, Canyon Co., *Macbride*, no. 301. WYOMING: Encampment, Carbon Co., *Tweedy*, no. 4228 (U.S.); La Barge, Uinta Co., *E. Stevenson*, no. 194 (U.S.); in spring-fed ponds, Evanston, Uinta Co., *Nelson*, no. 7195; Evanston, July 10-12, 1897, *T. A. Williams* (U.S.). COLORADO: in Laramie River, Aug. 4, 1891, *Crandall* (U.S.); Fort Collins, *Cowen*, no. 21; Twin Lakes, *Wolf & Rothrock*, nos. 112 & 113; in slow running stream, Montrose, Payson, no. 113; Ouray, *Shear*, no. 4145 (U.S.); Colorado Springs, *Curtiss*, U.S. no. 202,203; Cañon City, May 1877, *Brandeggee* (Cal.). UTAH: Corinne, *A. Wetmore*, no. 418 (U.S.); Rabbit Valley, Aug. 21, 1875, *L. F. Ward* (U.S.). NEVADA: Eagle Valley, Ormsby Co., *C. F. Baker*, no. 1052; Wadsworth, *Tidestrom*, no. 10,653 (U.S.). NEW MEXICO: Mimbres River, Grant Co., *O. B. Metcalf*, no. 1047; Trout Spring, vicinity of Las Vegas, *Arsène*, no. 18,326 (U.S.); vicinity of Ute Park, Colfax Co., *Standley*, no. 13,674 (U.S.); Negrito Creek, Aug. 1, 1900, *Wooton* (U.S.); Bartlett Ranch, Colfax Co., Sept. 1, 1913, *Wooton* (U.S.). ARIZONA: Tuba Oasis,

Clute, no. 130; Lakeside, White Mts., *G. J. Harrison*, no. 5487 (U.S.), a form somewhat atypical. CALIFORNIA: Borax Lake, *J. Torrey*, no. 4; Lake Merced, San Francisco, July 17, 1892, *Blankinship*; Eagle Lake, Lassen Co., July 23, ? , *M. S. Baker* (U.S.); Shasta River, near mouth, Siskiyou Co., *G. D. Butler*, no. 361 (Cal.); Eagle Lake, July 25, 1894, *Baker & Nutting* (Cal.); Yreka, Siskiyou Co., May, 1903, *W. T. Mooney* (Cal.). OREGON: pond, upper gap, Lost River, Cascade Mts., Klamath Co., *Applegate*, no. 3477 (Cal.). WASHINGTON: junction of Crab and Wilson Creeks, Douglas Co., *Sandberg & Leiberger*, no. 265. MEXICO: Pacheo, Chihuahua, *Hartman*, no. 680; Sierra Madre, Chihuahua, *E. W. Nelson*, no. 6025 (U.S.); vicinity of Madera, Chihuahua, *Palmer*, no. 262 (U.S.); near Colonia Garcia, Sierra Madre, *Townsend & Barber*, no. 115; Rancho Colorado, District of Guerrero, Chihuahua, *Mexia*, no. 2570.

In its typical form (FIG. 1), *Ranunculus subrigidus* is superficially similar to the European *R. circinatus* with which it has long been confused. Upon close study, however, it is found that the larger size of the petals of the European plant and, consequently, the greater number of veins are features which set apart *R. circinatus* from our *R. subrigidus*. Moreover, the veins of the petals of the European *R. circinatus* are usually more forked toward the distal extremity. Further, the leaves of *R. subrigidus* are only subrigid and rather flaccid, whereas those of the Old World *R. circinatus* are usually very rigid and stiff.

In addition to the typical *R. subrigidus*, there are two or three recognizable forms of it. One form, which appears to be common in the southwestern United States, particularly in Arizona, New Mexico, southern Utah, southern Nevada, and northern Mexico has long, flaccid, many-segmented, mostly sessile dissected leaves, the primary divisions of which are often rather elongate. The floral and fruiting structures of this plant, however, appear to be identical with those of the more typical form of *R. subrigidus*. Another form, which seems to me to be more common in California, has more or less flaccid dissected leaves, many of which are often distinctly petiolate; but the more fundamental characters of the plant clearly indicate its affinity to *R. subrigidus*.

The distinctions between *Ranunculus subrigidus* and *R. longirostris* become the more evident the greater the number of plants of each species that are studied. *R. subrigidus* closely resembles *R. longirostris* in habit; but, normally, each species has distinctive fruit characters. For example, *R. subrigidus* has from 30–80 (av. 40) carpels per fruiting head, whereas *R. longirostris* bears from 8 to 30

(av. 16) carpels. The immature carpels of *R. subrigidus* have long styles which do not usually persist to any marked extent at maturity (FIG. 4). The persistent style-bases of *R. longirostris*, on the other hand, are prominent, usually attaining a length of 1 mm. (FIG. 11). The mature achenes of *R. subrigidus* vary in length from 1 to 1.5 (av. 1.25) mm., whereas in *R. longirostris* the range is from 1 to 1.6 mm.; but the average size is about 1.5 mm. Moreover, the receptacle of *R. subrigidus* (FIG. 10), while varying from 1 to 2.5 mm., usually is 1.75–2 mm. in length. In *R. longirostris* (FIG. 14), on the other hand, the size of the receptacle ranges from 0.75 to 2 mm., but usually lies between 1 and 1.5 mm.

8. *R. LONGIROSTRIS* Godron (FIGS. 2, 11, 14). Plants with dissected immersed leaves only; leaves more or less circinate, definitely sessile, with prominent hairy stipular sheaths usually $\frac{1}{2}$ – $\frac{3}{4}$ adnate to the petiole: flowers 1–1.9 (usually 1.6–1.8) cm. in diameter: petal with 4–9 (av. 7) veins at the distal edge of the nectarial pit: stamens 10–18 (av. 15): carpels 8–30 (av. 16), glabrous or pubescent; mature achenes 1–1.6 (av. 1.5) mm. long, exclusive of the persistent style-base which is 0.3–1.5 (av. 1) mm. in length: receptacle 0.75–2 (usually 1–1.5) mm. long, mostly very hairy.—Essai, Mem. Soc. Roy. Nancy, 39, fig. ix. (1839); House, Mem. N. Y. State Museum xv. pt. 1, pl. 79A (1918), as *Batrachium circinatum* (Sibthp.) Reich., and Bull. N. Y. State Museum, no. 254: 339 (1924), as *Ranunculus longirostre* (is). *R. aquatilis* L., δ *stagnatilis* (Wallr.) DC., *sensu* Hook. Fl. Bor.-Am. i. 10 (1829), in part. *Batrachium longirostre* (Godr.) F. Schultz, Arch. Fl. Fr. et Allem. i. 71 (1842). *R. aquatilis* L., var. ? *trichophyllus* Lawson, Monogr. Ranunc. Can. and Adj. Pts. Brit. Am., Proc. & Trans. Nov. Scot. Inst. Nat. Sci. ii. pt. 4: 43 (1869). *R. hydrocharis* Spenn., forma *longirostris* (Godr.) Hiern, Journ. Bot. ix. 100 (1871). *R. aquatilis* L., var. *longirostris* (Godr.) Lawson, Rev. Can. Ranunc., Trans. Roy. Soc. Can. ii. sect. iv: 45 (1884). *R. circinatus* Sibth., *sensu* Gray, Rev. No. Am. Ranunc., Proc. Am. Acad. xxi. 363 (1886), in part. *Batrachium divaricatum* (Schrank) Wimm., *sensu* Britt. & Brown, Ill. Fl. ii. 84 (1897), in part. *B. circinatum* (Sibth.) Reichenb., *sensu* Britt. & Brown, Ill. Fl. ii. 116 (1913) in part.—In quiet waters (calcareous at least in eastern North America) from western Quebec to Oregon; south to Delaware, Pennsylvania, Tennessee, Nebraska, Kansas, Texas, Arizona and New Mexico. The following are representative: QUEBEC: Île Charron, Longueil, *Victorin & Rolland*, no. 29,089; dans les îles de Sorel, Île aux Corbeaux, *Adrien*, no. 1974. MASSACHUSETTS: Lake Buel, New Marlboro, *Churchill* (probably). CONNECTICUT: small pond at Lakeville, Salisbury, Aug. 19, 1903, *Bissell*; in several feet of water, Mudge pond, Sharon, *Weatherby & Anderson*, no. 5900; Salisbury, June 3, 1931, *Weatherby & Drew*. NEW YORK: Cayuga Lake, north of RR. bridge, *Dean & Thomas*, no. 4049; in water of Sterling Creek, North Fairhaven, Cayuga Co., *Hughes & Douglas*,

no. 4050; "Red-house" bridge, s. Beaver Creek, north of Kingsbury St., Washington Co., July 14, 1900, *Burnham*; ponds along Lake Ontario, Woodville, *House*, no. 8156; slough-hole near Crass River, Canton, *Phelps*, no. 451; slow stream, Pecksport, Madison Co., July 10, 1918, *House*; stagnant pond, South Butler, Wayne Co., *Mac Daniels & Munz*, no. 6436; western New York, *Sartwell*; Thousand Islands, Aug. 8, 1879, *L. F. Ward* (U.S.); Sodus Bay, Wayne Co., July 12, 1884, *O. E. Pearce* (U.S.); Oswego River, Minneto, June 24, 1880, *O. E. Pearce* (U.S.); vicinity of Pittsford, Monroe Co., *Killip*, no. 2108 (U.S.). PENNSYLVANIA: shallow pool in Common Creek, Tullytown, Bucks Co., Aug. 4, 1927, *Benner*; Presque Isle, Erie, June 2, 1880, *G. Guttenberg* (U.S.). DELAWARE: Wilmington, *Tatnall*. ONTARIO: Belmont, June 23, 1905, *G. L. Fisher*; in the Rideau River, near Ottawa, *J. M. Macoun*, no. 67,787; stagnant water, Galt, *Herriot*, no. 45; marshes, Wallaceburgh, *Macoun*, no. 33,588; near Sarnia, *Dodge*, no. 26; Squirrel Island, Lambton Co., Aug. 13, 1903, *Dodge* (U.S.); St. Thomas, June 23, 1905, *G. L. Fisher* (U.S.); Wingham, June 25, 1898, *J. A. Morton* (U.S.); edge of old canal, St. Catherine, *McCalla*, no. 377 (U.S.). MICHIGAN: cove in Belle River, St. Clair Co., *Dodge*, no. 25; Vandercook's Lake, Jackson Co., May 29, 1896, *S. H. & D. R. Camp* (U.S.); Port Huron, June 3, 1896, *Dodge* (U.S.); pool nw. of Cedar Springs, June 18, 1897, *C. W. Fallass* (U.S.); Dexter, *Elmore Palmer* (U.S.); shallow streams, Hubbardston, 1880 (U.S.); Elizabeth Lake, Oakland Co., June 8, 1913, *B. F. Chandler* (U.S.); Mill pond, Alma, May 20, 1890, *C. A. Davis* (U.S.). OHIO: Mentor Marsh, Lake Co., July 9, 1923, *R. J. Webb*; East Twin Lake, Portage Co., *R. J. Webb*, no. 1300; Castalia, Aug. 23, 1895, *Moseley* (U.S.); Newark, 1888 (?), *Riddell* (U.S.); Vermillion, Erie Co., May 13, 1889, *L. M. McCormick* (U.S.); Lancaster, *J. M. Bigelow*, U.S. no. 798. INDIANA: four miles east of Russelville in old Bayou of Raccoon Creek, *Grimes*, no. 499; Pine Lake, *Mell*, no. 119 (U.S.); Little Maxincuckee Lake, *Evermann*, no. 680 (U.S.). TENNESSEE: swamps along Cumberland River, 1886, *Gattinger* (U.S.), a semi-terrestrial mud-form. WISCONSIN: shallow water, Lake Wingra, Dare Co., *Fassett*, no. 3526; Whitney's Slough of Green Bay, June 14, 1886, *Schuette*; Milwaukee, *Lapham*; Marshy Lake, vicinity of Delavan, *N. Hollister*, no. 15 (U.S.). ILLINOIS: in shallow water, Stony Island, *Greenman*, no. 2616; in a swamp, Crystal Lake, Urbana, *Gleason*, no. 555; small pond north of Urbana, June 27, 1906, *Gleason*; Dorr's Pond near Mt. Carmel, June 30, 1888, *Schneck*; Lakes, St. Clair Co., May 25, 1877, *Eggert*; Bluffs Lake, *Eggert*, no. 27 (U.S.); near Oquawka, June 30, 1873, *Patterson* (U.S.). IOWA: Fayette, May 1894, *Fink*; Estherville, June 1881, *Cratty* (U.S.); Iowa City, June 19, 1883, *Shimek* (U.S.). MINNESOTA: Minnetonka, July 24, 1891, *Sandberg* (U.S.); Mississippi River, Clearwater Co., *J. B. Moyle*, no. 438; Silver Lake, Otter Tail Co., Aug. 1892, *Sheldon*. MISSOURI: Forest Mill, *E. J. Palmer*, nos. 3783, 2313. SOUTH DAKOTA: mouth of Spring Creek, Roberts Co., *Over*, no. 14467 (U.S.); White, June 17,

1893, *Thornber* (U.S.). NEBRASKA: Neligh, May 13, 1896, *E. S. Bacon*; Hershey, *Mell*, no. 88 (U.S.); Marsh Lake, *R. Thomson*, no. 26 (U.S.); Willow Lake, *R. Thomson*, no. 123 (U.S.); Petersoon Lakes, *R. Thomson*, no. 333 (U.S.), a sterile plant; in Dismal River, Thomas Co., July 13, 1889, *H. J. Webber* (U.S.); Keya Paha, *F. Clements*, no. 2867 (U.S.); in Lodge Pole Creek near Lodge Pole, Cheyenne Co., Aug. 29, 1891, *Rydberg* (U.S.). KANSAS: ponds, Riley Co., *Hitchcock*, no. 976. TEXAS: Lipscomb, *A. H. Howell*, no. 11 (U.S.); bed of Limpia, *Wright*, nos. 437, 835. MONTANA: North fork, Iona River, *Scribner*, no. 2; Shields River above Wilsall, *Suksdorf*, no. 97; Ennis, July 27, 1898, *E. A. Maynard*; Boiling River, *P. H. Hawkins*, no. 755 (U.S.). COLORADO: pond, Denver, Denver Co., *Duthie & Clokey*, no. 3764; divide between Arkansas & South Platte Rivers, at "Elbert" station on RR., circa 1883, *R. W. Woodward*. UTAH: Jordan Valley, *S. Watson*, no. 15; along Sevier River, above Marysville, *Rydberg & Carlton*, no. 6930 (U.S.); Cache Co., June 27, 1897, *J. H. Linnford* (U.S.). NEVADA: Mountain City, *Nelson & Macbride*, no. 2202; alkali flat, Elko, *A. E. Hitchcock*, no. 943 (U.S.); in water, vicinity of Cold Creek, *A. E. Hitchcock*, no. 1072 (U.S.), lacking fruit. NEW MEXICO: Rio Mimbres, *Thurber*, no. 216. ARIZONA: El Paso and Ft. Yuma Wagon Rd. Expedition, *Sutton Hayes*, no. 7. OREGON: Lt. Mullen's Expedition, U. S. no. 801.

Ranunculus longirostris is best treated as a distinct species, endemic in North America, which is closely related to *R. subrigidus* and more remotely to the European *R. circinatus*. The presence of the long, persistent style-base of the mature achene of *R. longirostris* was the fundamental character upon which Godron based the species. The distinctions between *R. subrigidus* and *R. longirostris* have been emphasized in the discussion of the former.

Ranunculus longirostris can be separated from *R. trichophyllus* with little difficulty since the long beak of the achene and the sessile, more or less circinate leaves sharply set it off from the latter. A further rather striking difference between the two species is shown by the broad, hairy, auricled stipular sheaths which characterize the leaves of *R. longirostris*. Only very rarely do the stipular sheaths of *R. trichophyllus* approach the size attained in the long-beaked *Batrachium*. Moreover, the amount of adnation of the stipular sheaths of *R. longirostris* is much less than in *R. trichophyllus* in which the sheaths are mostly completely adnate to the petioles.

Ranunculus longirostris has frequently been confused with one species or another by North American taxonomists. The plant was not recognized as a distinct species until Godron described it from a specimen in Riehl's Herbarium, which was labelled *R. divaricatus* Schrank.¹ The type station is given by Godron as follows: "Hab.

¹ Riehl, pl. exs. no. 52 sub nomine *R. divaricati* Schrank.

in aquis fluentibus Americae Borealis propè Saint Louis, Missouri." There is no doubt from the clear description and the accompanying plate that Godron was dealing with a typical plant of the species. The early *Ranunculus aquatilis*, δ *stagnatilis* of Hooker (1829) and of Torrey and Gray (1838) included both *R. longirostris*, which had not been recognized at that date, and *R. subrigidus*. Lawson, in his later (1884) studies on the Canadian *Ranunculi*,¹ treated *R. longirostris* as a variety of *R. aquatilis*. From his description it is evident that he was dealing with an abnormal plant of *R. longirostris*, since that species does not appear to develop adventitious roots extensively under normal conditions. In his earlier work (1870),² Lawson refers to *R. aquatilis*, var. *trichophyllus*? which, judging from the fact that this specimen was included under *R. aquatilis*, var. *longirostris* of the later publication (1884), was probably the plant treated here as *R. longirostris*. At any event, Lawson was the first North American botanist to recognize this characteristic *Batrachium* as something different from the European *R. circinatus*. In 1886, Gray, in his Revision of the North American *Ranunculi*,³ studied the *Batrachia* extensively; but he included *Ranunculus longirostris* under *R. circinatus*. Largely following the treatment of Britton and Brown,⁴ Davis, in his taxonomic study of the North American *Ranunculaceae*,⁵ reverts to the misinterpreted name, *Batrachium divaricatum* (Schrank) Wimm., to include *Ranunculus longirostris* and the exclusively Old World *R. circinatus*. As explained under the discussion of *R. divaricatus*, in relation to *R. trichophyllus*, the former name was misapplied by many continental botanists, including Wimmer, to the true *R. circinatus*, on the basis of the word "tellerförmig" by which Schrank characterized the foliage of his plant. Williams⁶ has since pointed out the true nature of Schrank's plant. In the meantime, unfortunately, the misinterpreted European *R. divaricatus* found its way into several North American botanical studies as our circinate-leaved *Batrachium*.

Greene⁷ described a *Batrachium usneoides* from a peculiar plant collected at Lake City, Arkansas.⁸ I have examined the plant from

¹ Trans. Roy. Soc. Can. ii. sect. iv. 45 (1884).

² Proc. & Trans. Nov. Scot. Inst. Nat. Sci. ii. pt. iv: 42-43 (1869).

³ Proc. Am. Ac. xxi. 363 (1886).

⁴ Ill. Fl. ii. 84 (1897).

⁵ Minn. Bot. Studies ii. 460-462 (1900).

⁶ Journ. Bot. xlv. 14 (1908).

⁷ Leaflets Bot. Obs. & Crit. ii. 106 (1910).

⁸ ARKANSAS: Lake City, A. H. Howell, no. 606 (U. S.).

the original collection which is now in the United States National Herbarium. A study of this material shows that the young achenes, apparently hitherto unnoticed, are very similar, in having long styles, to those of *R. longirostris*. It seems likely that if mature fruiting specimens of the plant were collected, its close relationship to *R. longirostris* would be evident, since in other characters *B. usneoides* approaches *R. longirostris*. Thus, for example, the much-divided, dissected leaves of *B. usneoides*, unique as far as I know among *Batrachian Ranunculi*, are quite sessile, though primary, secondary, and even tertiary divisions are long-stalked. Moreover, these essentially sessile leaves are subtended by large hairy stipular sheaths of the *R. longirostris* type. For the present, then, *B. usneoides* seems better regarded as a somewhat unusual form of *R. longirostris*; in the event that more complete specimens of this plant are secured, its true affinities will become known.

9. ***R. pueblensis***, sp. nov. (TAB. 406, FIGS. 3, 7). Planta habitu *R. trichophyllo* similis; foliis omnibus submersis capillaceo-partitis sessilibus, segmentis primariis longe petiolulatis (0.6–1 cm.); stipulis amplis immaturis connatis; staminibus plerumque circa 10–12; carpellis 10–12, glabris; acheniis maturis longissimis, circa 2.5–3 mm. longis; rostello breve et crasso subrecurvato; receptaculo obovato piloso circa 2 mm. longo. *R. trichophyllus*, var. *mexicanus* Lévl. Bull. Geogr. Bot. xxii. 184 (1912), not *R. mexicanus* Davis, Minn. Bot. St. ii. 487 (1900).—This extremely local plant has been collected from only one station. MEXICO: Puente de Animas, alt. 2140 m., vicinity of Puebla, State of Puebla, *Bro. Nicolas*, no. 5948 (TYPE in Gray Herb.).

Although this plant appears to have been collected from only one station in Mexico, it is distinct enough from *R. trichophyllus*, which it simulates in general habit, to be worthy of separate specific rank. The achenes of *R. pueblensis* (FIG. 7) are markedly different from those of *R. trichophyllus* (FIG. 13), in that they are very large (2.5–3 mm., as contrasted with the usual length of 1.25–1.5 mm. in *R. trichophyllus*) and bear comparatively stout persistent style-bases which tend to be recurved. Moreover, the pattern of wrinkles is much coarser than that of the usual achene of *R. trichophyllus*. Furthermore, the leaves of *R. pueblensis* (FIG. 3), though long and more or less flaccid, as in *R. trichophyllus*, are sessile (or rarely short petiolate) at the top of the stipular sheaths; but the primary divisions are long-stalked. The leaves of *R. trichophyllus* are usually very definitely long-petiolate. A complete flower was missing from my specimen, but from the size of the head of stamens and carpels I judge it to be about 1.5 cm. in diameter.

Although *R. pueblensis* has sessile leaves as in *R. longirostris*, its achenes are much larger than those of *R. longirostris* (FIG. 11), 2.5–3 mm. as contrasted with 1.5 mm. in typical *R. longirostris*, and are about half as numerous (8–10 in *R. pueblensis* as against an average of 16 for *R. longirostris*). Whereas the leaves of *R. longirostris*, though usually sessile, are more or less definitely circinate in outline, those of *R. pueblensis* are never of that type. Moreover, the stipular sheaths of *R. pueblensis* are not the broad hairy flaring type found in *R. longirostris*. It appears to me, then, that this Mexican plant is wholly distinct from any known North American and European species. Indeed, the only other species of *Batrachium* in North America which bears large fruits at all comparable to those of *R. pueblensis* is *R. Lobbii*, the achenes of which attain an average size of 2.25 mm. However, the achenes of *R. Lobbii* bear a very small and distinctly lateral beak (FIG. 12), whereas those of *R. pueblensis* possess stout, more or less recurved persistent style-bases, sub-terminal in position. Thus, *R. pueblensis*, like numerous other plants from the vicinity of Puebla, Mexico, is clearly an endemic species.

ACKNOWLEDGMENTS

I am especially indebted to several persons who, in many ways, have helped me in the preparation of this paper: to Professor M. L. Fernald for inspiration and thoughtful guidance; to Mr. C. A. Weatherby for many valuable suggestions; to Mr. W. H. Pearsall for instructive advice on the British *Batrachia*; and to my wife for her untiring assistance.

EXPLANATION OF PLATE 406

FIG. 1, portions of flowering stems, $\times 1$, of *RANUNCULUS SUBRIGIDUS* n. sp., from TYPE, York River, Gaspé Co., Quebec, July 29, 1905, *Williams, Collins & Fernald*; FIG. 2, portions of flowering stems, $\times 1$, of *R. LONGIROSTRIS* Godron, from Sarnia, Lambton Co., Ontario, *C. K. Dodge*, no. 26; FIG. 3, portion of stem, $\times 1$, of *R. PUEBLENSIS*, n. sp., from the TYPE, Puente de Animas, Puebla, Mexico, *Nicolas*, no. 5948; FIG. 4, achenes, $\times 10$, of *R. SUBRIGIDUS*, from the TYPE; FIG. 5, plant, $\times 1$, of *R. TRICHOPHYLLUS* Chaix, var. *ERADICATUS* (Laest.) Drew, from vicinity of Harry's River, Newfoundland, *Fernald & Wiegand*, no. 3408; FIG. 6, receptacle, $\times 10$, of *R. TRICHOPHYLLUS*, var. *TYPICUS*, from California, 1864, *Bolander*; FIG. 7, achenes, $\times 10$, of *R. PUEBLENSIS*, from the TYPE; FIG. 8, achenes, $\times 10$, of *R. TRICHOPHYLLUS*, var. *CALVESCENS*, n. var., from the TYPE, Crams River, Danvers, Massachusetts, July 2, 1885, *J. H. Sears*; FIG. 9, receptacle, $\times 10$, of *R. TRICHOPHYLLUS*, var. *CALVESCENS*, from the TYPE; FIG. 10, receptacle, $\times 10$, of *R. SUBRIGIDUS*, from the TYPE; FIG. 11, achenes, $\times 10$, of *R. LONGIROSTRIS*, from Sarnia, Ontario; FIG. 12, achenes, $\times 10$, of *R. LOBBII* (Hiern) Gray, from Corvallis, Oregon, April 23, 1934, *H. M. Gilkey*; FIG. 13, achenes, $\times 10$, of *R. TRICHOPHYLLUS*, var. *TYPICUS*, from California, 1864, *Bolander*; FIG. 14, receptacle, $\times 10$, of *R. LONGIROSTRIS*, from Sarnia, Ontario.